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RAPID TELEPHONIC GROWTH.

The fact that the Pacific Coast has witnessed an extremely rapid development of the telephone is well known, but the causes for such growth have not hitherto been discussed. We are glad, therefore, to present in this issue an interesting article on the subject by a staff correspondent, who has just been over the ground and made a careful study of the work on the spot. The present article will be followed by one or two others, discussing various technical and popular aspects of the telephonic situation on the Pacific Coast. It would seem that the policy of Mr. Sabin and his associates presents many points for imitation, and some which, if not imitated, will furnish food for thought. His goal is that at which all telephonists are aiming—the greatest possible profitable use of the system by the public.

THE INSTITUTE CONVERSAZIONE.

The Conversazione at Columbia University on the evening of April 12 formed the occasion of an interesting and successful meeting. Such functions are necessarily of a social character, and they are agreeable substitutes for dinners in that while a dinner is an interesting excuse for bringing a number of men together who are interested in different aspects and branches of the same art or science, yet at a dinner one's social environment is frequently limited almost entirely by one's right-hand and left-hand companion. At a conversazione the excuse for a social gathering is the collection of exhibits, and one's social environment is unbounded.

The first difficulty with a conversazione lies in securing such attractive features as shall ensure its success by reason of sufficient attendance, and the second difficulty is usually to prevent the success from being a failure by reason of overcrowding. The only solution of the difficulty from overcrowding lies in providing sufficient space for the guests in a sufficiently spacious hall. Conversaziones of scientific societies have on several occasions ended disastrously by unscientific management of apparently unimportant particulars, such as the care and checking of hats and coats. It is not so long since the guests of a heavily thronged conversazione in Europe had to go home hatless and coatless after a long, free fight in the vestibule over garments which were thrown into disorder by insufficient attention and provision for so numerous a gathering. It is to be hoped that in view of the success attending last week's Conversazione, each year may see one of these gatherings of the members of the A. I. E. E. in addition to or as an alternative to the annual dinner and the annual convention.

Those who attended the conversazione—some 1200 people—must have been impressed, as were all with whom we have talked over the affair, with the ease and smoothness with which the arrangements throughout met all the conditions, and next, with the unusually high average of the exhibits. Such demonstrations as those of Professor Thomson, Peter Cooper Hewitt and Nikola Tesla are necessarily not made very often, and on this occasion they were but three out of thirty displays of the best class, with all mere advertising rigorously excluded and with strong emphasis on the scientific side. The latest phenomena, the newest instruments, the novel applications were all there, and the only drawback was that they all had to be seen and studied in the space of about three hours. But each individual could

concentrate on the things of most personal interest, and this in itself helped to scatter the crowd and keep it in circulation. On the whole, the Conversazione must be declared a brilliant success, gratifying to all whose efforts contributed to that end and creating a warmer and stronger interest than ever in the Institute, for whose growth and welfare it was projected.

Chemical Formulae and the Theory of Invariants.

The theory of invariants has hitherto remained a branch of quantics and, therefore, a branch of pure higher mathematics. It has been so pure that no shadow of utility seems to have perturbed its serenity. It is of comparatively recent origin, and before Boole and Cayley, invariants and covariants were not. In the report of a recent meeting of the Physico-Medical Society at Erlanger, is a paper by Messrs. P. Gordon and W. Alexejeff, setting forth an analogy appearing to exist between groups of chemical compounds of definite atomic relationship, and groups of invariants obtained by the algebraical methods of transformation and substitution.

If the theory propounded is found to be correct, we might expect it to lead to some modification of ideas on the classification of chemical compounds. At present it is recognized that there is no limit to the structural complexity of molecules, and that there is no limit to the number of possible chemical compounds or unions between atoms. The number of possible groupings and resulting compounds up to a certain range of complexity is so great that it is hopeless to attempt an enumeration of them.

If, however, the invariant theory should be found tenable, then owing to the labors of pure mathematicians already garnered, the numbers of substitution products in algebra up to and including a given range of complexity can be applied immediately to substitution products in chemistry, and products may be found capable of classification on a purely algebraical basis. But whether the theory of invariants, as applied to chemical formulæ, be reliable or not, it is evident that we may expect to find no field of mathematics so pure or remote from application but that the applied scientist will seek to lay hold of it. It would seem, in fact, as though the time and hope of the old philosopher were passing away, when he thanked Providence that he had hit upon a line of mathematical study for which no utilization was possible.

Expert Testimony.

We never look over the reports of a technical case involving the consideration of much expert testimony without wishing for radical changes in the present course of practice. We shall not here enter into the ethical consideration of the matter, assuming that so far as electrical cases are concerned the experts are acting in entire good faith and telling the truth as they understand it. Electrical science has advanced far enough to put its essential principles beyond dispute, but nevertheless there is left ample opportunity for wrangling over their application. In interpreting the technical features of a patent, for instance, two entirely conscientious and thoroughly trained experts may take points of view radically different, and arrive at utterly diverse conclusions. For patent specifications are seldom—we might almost say never—so drawn as to make the inventor's real understanding of the case fully evident. They are, as a rule, drawn by attorneys who are anxious to get the patent in as good legal shape as possible for the defence of their client's interests, and it very often happens that the objections of the examiner are met by purely verbal changes, which, while satisfying his formal requirements also serve to cloud the original clear expression of the inventor's intentions. When such a patent is put in litigation, it becomes, particularly if the art has been rapidly advancing, almost impossible to tell how fully the principles involved were in the inventor's mind and how completely his disclosures have anticipated the work of others. Instances of this kind lead to radical difference of opinion among experts, and derision of expert testimony on the part of the unthinking public. And the complete freedom allowed attorneys and experts in the ordinary course of testimony before an examiner tends to produce constant thrust and parry, shifty questions and elusive answers that put the expert in still worse repute when perhaps he is merely trying to avoid an ingenious attempt to extract from him an answer which, while verbally true, can be twisted in the coming brief to mean something entirely different.

In cases before referees, auditors and juries the plight of the expert witness is even worse. There are no well determined rules of expert testimony, and it often happens that hours are taken up in wrangling over the admission of some bit of technical evidence which all the parties concerned know perfectly well to be pertinent and important. We do not wish to cast aspersions on our friends the lawyers, but it certainly appears to the layman that a large part of their time is taken up in court with strenuous endeavors to prevent the whole truth from reaching the ears of the jury. Any one with the most rudimentary knowledge of technical matters knows that many questions, even when asked in perfectly good faith, cannot be answered categorically without stating half truths, and yet the Court often compels an expert witness to answer thus or say he cannot so answer, when it is perfectly evident that either alternative really conceals the facts. In cross examination the questions are frequently deliberately ambiguous or intentionally misleading, and there is at present no adequate means for checking this tendency. Nor is there usually any tendency on the part of the Court to restrain blackguardly attorneys, of whom the courts are never entirely rid, from miscellaneous abuse of the witness in an attempt to blacken his professional character and discredit his testimony. In patent practice the witness can at least defend himself, but in court work he is absolutely at the mercy of any pettifogger who is bent upon defeating justice. Even on direct examination hypothetical questions can be, and often are, put in such terms that an absolutely truthful answer will of necessity convey a false impression to the hearers. If in addition the expert is disposed to strain a point, there is almost no limit to the deception that can be practiced without deliberate falsehood on the part of any one. In such a state of affairs it is small wonder that expert testimony is sometimes looked upon with suspicion.

It seems to us that the remedy is to be sought in the formulation of definite rules of expert testimony, which is essentially different from ordinary fact testimony, and in an extension of the applied powers of the Court. In the first place, the qualification of the witness should be made once for all by the Court and in the most rigorous manner, and when his competence is so determined he should be protected from attack upon his qualifications. If such was the practice neither side would dare to put on an improperly qualified man and risk the effect of his being excluded by the court, nor would such a man venture to appear as a witness. In the next place, there should be a definite place given to expect testimony. At present, in patent practice, the witness is allowed unhindered to testify to fact and hypothesis at his own sweet will, while in court practice he is usually cross examined on the theory that his professional qualifications are of no value, and that data not obtained by his own personal experiments are to be classified as heresay evidence and

excluded. The former course is absurdly loose, while the latter practically denies the existence of expert testimony as such. Some common ground should be formed between these two extreme positions and so defined that there should be uniformity in all legal proceedings. Finally, it would be a very desirable thing if the Court were permitted to retain expert assistance at its discretion or at the request of either party to the litigation, for the obvious purpose of sifting the technical evidence into such form that the Court can utilize it. The average judge has a great deal more acute appreciation of technical matters than he is popularly credited with, but it takes real expert knowledge of the details of a subject to get to the bottom of disingenuous hypothetical questions and evasive technicalities. For this purpose an expert retained by the Court, or, still better, permanently attached to it, would promote the ends of justice to no small degree.

Aluminium for Lines.

The present and continuing high price of copper has created a strong tendency to replace it with aluminum wire whenever feasible as a measure of economy. Of course, one cannot predict the future of the copper market, influenced, as it is, by pools, corners and combinations of various sorts, by the exploitation and possible operation of new mines, and by the chance for the development of new mining regions. It seems tolerably evident, however, that the demand is so great that the tendency of the market is decidedly upwards from the low plane of a few years ago. In view of this fact, the introduction of aluminum as a serious competitor has come about naturally enough, and we have from time to time noted in our columns the erection of a goodly number of aluminum transmission lines, some of them on a very large scale. On the whole, such lines have been successful, but some recent experiments abroad have tended to throw not a little doubt on their probable endurance. The matter is a very important one industrially, and there is real need for a thorough investigation of it. As in most mooted questions there are many pros and cons to be discussed.

The fundamental facts regarding aluminum are as follows: The white metal when pure has, weight for weight, just double the conductivity of copper; that is, of two lines of equal conductivity, the aluminum one will have just half the weight of the copper one. The cross-section of the former, however, will be about 1.64 times that of the latter, and its diameter about 1.27 times greater. The tensile strength of the aluminum line would be about 62 per cent that of the copper, supposing the latter to be hard drawn; but the copper in addition is perceptibly the tougher of the two. Its elastic limit is also somewhat higher, the aluminum taking permanent set very easily indeed. The linear expansion for each degree of rise in temperature is 1.4 times greater for aluminum than for copper, and while the former melts at 600 degs. to 700 degs. C., the latter becomes fluid only at 1000 degs. to 1100 degs. C. At present it is far easier to get pure copper than pure aluminum, since the latter is very hard to rid of the last traces of certain impurities, notably iron, and is produced by a process which presents some difficulties in the way of getting a uniform product. Chemically, the copper is far more stable as regards atmospheric influences. In the electrochemical series aluminum stands near the electro-positive end of the list, being followed only by such metals as magnesium, calcium and the like, so that when in electrolytic combination with any of the common metals, even iron and zinc, it is the aluminum that suffers. It is especially susceptible to salt water in every form. And, finally, while copper can be joined with solder very readily, aluminum is soldered only with great difficulty, and joints so made are of very dubious strength and permanence. This list of properties appears at first sight unfavorable to the use of aluminum, but there is more than one side to the question when put on an economic basis.

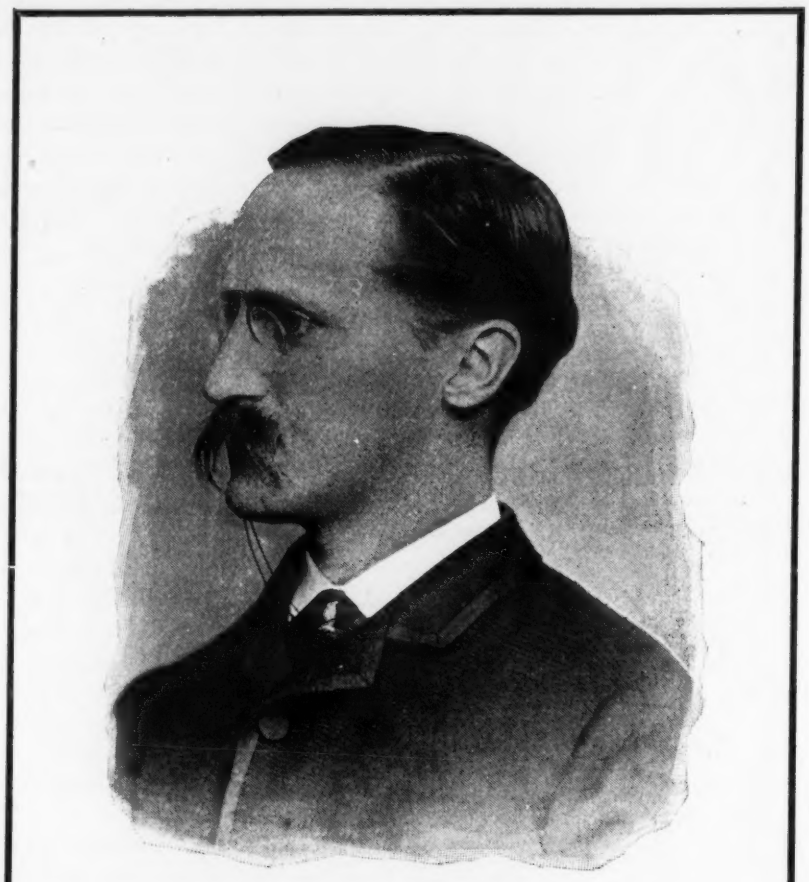
In the first place, the fact stands out conspicuously that in the first cost of material aluminum at even 30 cents per pound is as cheap as copper at 15 cents, and at 20 cents becomes equivalent to 10-cent copper. Moreover, if as very frequently happens, particularly in power transmission work, freights are a serious item of expense, every dollar spent in freights on the aluminum line is a dollar saved over the transportation charges on the equivalent copper line. This gain extends to the whole matter of distribution and handling of the wire. Against it has to be set the extra labor in stringing the aluminum, arising from the extra care that has to be taken in spite of the lessened weight. The added pains arise in part on account of using a weaker material, but especially on account of its very much greater expansion with temperature than in the case of copper. This implies much caution in stringing the wire under uniform tension, and adjusting the tautness of the line very carefully with relation to the temperature. Systematic use of thermometer and tension dynamometer are precautions somewhat novel in line construction of the ordinary sort; but, after all, the main thing is to get the line foreman into the knack of working thus, and the real added cost in dollars and cents is not so large as would appear at first thought. Joints are a far more serious problem. Soldering in the ordinary sense is practically out of the question at present, and the best results seem to have been reached by slipping the wires tightly into an aluminum sleeve and securing it by twisting. If such a joint could be air and water tight one could feel sure of its permanence, but in the case of salt fogs there is every reason to expect corrosion at a fairly rapid rate. The aluminum line has for the same conductivity as copper somewhat larger capacity and inductance, but the difference is not great enough to be material. It is also an easier victim in case of an accidental arc being established, but inasmuch as this is likely to be disastrous in any case, it is doubtful whether the lower fusing point of aluminum is practically of much account.

The improvement of methods of manufacture so as to ensure a homogeneous product of uniform quality and free from flaws, and the solution of the joint problem are the two things most important in the adaptation of aluminum to every-day use in line work. The other difficulties are of minor importance, and not to be seriously considered. If copper holds near its present price, it is safe to say that the incentive to use aluminum will be sufficient to ensure a thorough study of the case, and the presentation of remedies for the present difficulties. In much present and future work the cost of the line conductors is and will be so considerable an item in the total investment that even at present prices copper would hardly be in the game. A real stimulus to the aluminum industry would mean cheapening of production to a point at which even far cheaper copper than we now have could not successfully compete with it. In any case, it is safe to say that the genial theorists who consider a copper line in the jungle as a quick asset upon which securities can be successfully floated, may well stop and meditate a bit on the future of aluminum, and with them should commune the promoters who are opening low-grade copper mines on the strength of the present market. Copper, presumably, we shall have with us always, but at a pinch the electrical industries could get along on much less than at present.

Death of Prof. Henry A. Rowland.

As we go to press a dispatch announces the death of Professor Henry A. Rowland. Professor Rowland was born at Honesdale, Pa., Nov. 27, 1848, and was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1870. A year later began the career of scientific investigator and teacher which gave him such an enviable position among the American scientific names of the century.

His father, the Rev. H. A. Rowland, was a scholar of distinction and of old Connecticut Congregational stock, a graduate of Yale and Andover, and a pastor in the Presbyterian Church for nearly 30 years. It is evident that the genius of the boy soon found its object, for he determined on a scientific course and entered Rensselaer Polytechnic Institute at Troy, from which he was graduated as a civil engineer. The next year found him railroad surveying in Western New York, but his ability as a teacher was already recognized, and his services were called into requisition at Wooster University. In 1872 he returned to Rensselaer as instructor in physics, and in 1874 he became assistant professor.



THE LATE PROFESSOR HENRY AUGUSTUS ROWLAND.

In the meantime, he had completed his now widely known experiments on magnetic permeability, but at first he was unable to get them published. The scientific journals in America rejected his work, but, confident of its value, he sent his results to Clerk Maxwell, who at once had them published in the *Philosophical Magazine*. He was now becoming known, and when the authorities of the newly founded Johns Hopkins University, at Baltimore, cast about them for some one to fill the chair of physics and become director of the physical laboratory, Professor Rowland, with his already recognized ability, and with the countenance which Maxwell's recognition of his talents gave, was chosen for the place. This was a year before the University actually opened, and the interval he spent in Europe, working in Berlin with Helmholtz. Here he investigated the effect of static electricity in motion, and later offered the first proof of Maxwell's great hypothesis on the identity of electromagnetic and luminous undulatory transmission by demonstrating that a static charge moving with the velocity of light has the effect of a current. In accordance with an international agreement, Professor Rowland was selected by the United States Government to determine the absolute value of the ohm.

While the energies of Professor Rowland were largely devoted to exhaustive researches into the nature and phenomena of electricity and magnetism, his work took a broad sweep through pretty well the whole range of physics. He devised a very exact method for determining the mechanical equivalent of heat, and the valve obtained by him replaced that which had hitherto been accepted by science. To the public his name is probably even more familiar in connection with his large diffraction gratings, which are ruled by a method of his own directly on concave mirrors, the image of the solar spectrum being thus produced without the aid of lenses. In fact, the photographs of the spectrum obtained with the aid of these gratings far exceed anything else of the kind, and their exhibition before the National Academy of Sciences in 1883 was one of the leading scientific events of the year. Professor Rowland's friends claim for him the discovery of the phenomenon known as the Hall effect.

The well-earned degree of Ph.D. was conferred upon Professor Rowland by Johns Hopkins University in 1880. As a member of the Electrical Congress at Paris in 1881, and of the jury at the Electrical Exhibition at the same time and place, he received the order of a Chevalier of the Legion of Honor. In 1881 he was elected a member of the National Academy of Sciences. In 1883 he presided over the Physics Section of the American Association for the Advancement of Science, at Minneapolis, and read a memorable address, entitled "A Plea for Pure Science." In 1884, being appointed by the Government on the commission specially formed for the purpose, he presided over the deliberations of the National Conference of Electricians at Philadelphia, and delivered an address. During the same year he received from the American Academy, of which he is an associate, the Rumford medal for his researches in light and heat, and since then other well merited honors have fallen to his share. In 1893 he was elected presiding officer of the International Electrical Congress, sitting at Chicago. During the past eight years Professor Rowland has devoted much time to the perfection of a system of rapid telegraphy, a working exhibit of which formed perhaps the most interesting feature of the American Electrical section of the recent Paris Exposition.

Professor Rowland was the author of many papers of great importance, most of which relate to his far-reaching researches into various scientific subjects. In addition to developing the resources of the physical and electrical laboratories at Johns Hopkins, where, in addition, an electrical testing bureau has been established by him, Professor Rowland in some manner continued to devote time to many other matters of importance. He was corresponding member of the British Association for the Advancement of Science, and of the Cambridge Philosophical Society; was one of the 12 foreign members of the Physical Society of London, and a permanent member of the International Commission for establishing electrical units. Quite recently Professor Rowland appeared before a Senate committee at Washington and delivered an argument in favor of the measure establishing the National Standardization Bureau. He was the first president of the American Physical Society.

As a teacher, Professor Rowland was a constant source of inspiration to students. As in the case of other great teachers of original cast of mind, his thoughts in the lecture room at times soared beyond the ken of the auditors, but none the less influenced their minds toward higher aims. A strong bond existed between the Professor and students, and the expression "A Rowland man," as applied to Johns Hopkins graduates, has come to have a significance even higher than that of a learned degree.

The Development of the Telephone on the Pacific Coast.

MORE telephones are used in proportion to the population in the Pacific Coast States than anywhere else in the United States. This condition of affairs makes the telephonic development in that territory a subject that is worth investigation by all interested in telephone work.

The Pacific States Telephone & Telegraph Company is the Bell organization which operates in the States of California, Oregon, Washington, Nevada and a part of Idaho. The independent telephone movement has not as yet assumed much importance in those States. Owing partly to its distance from Eastern examples and men, and partly to the capacity of the company's management for going ahead on original lines, the Pacific States Telephone & Telegraph Company has pursued lines of policy which differ considerably from the Eastern Bell companies. While many of the methods adopted have probably been looked at doubtfully by Eastern telephone managers who knew of them, the results in the way of a tele-

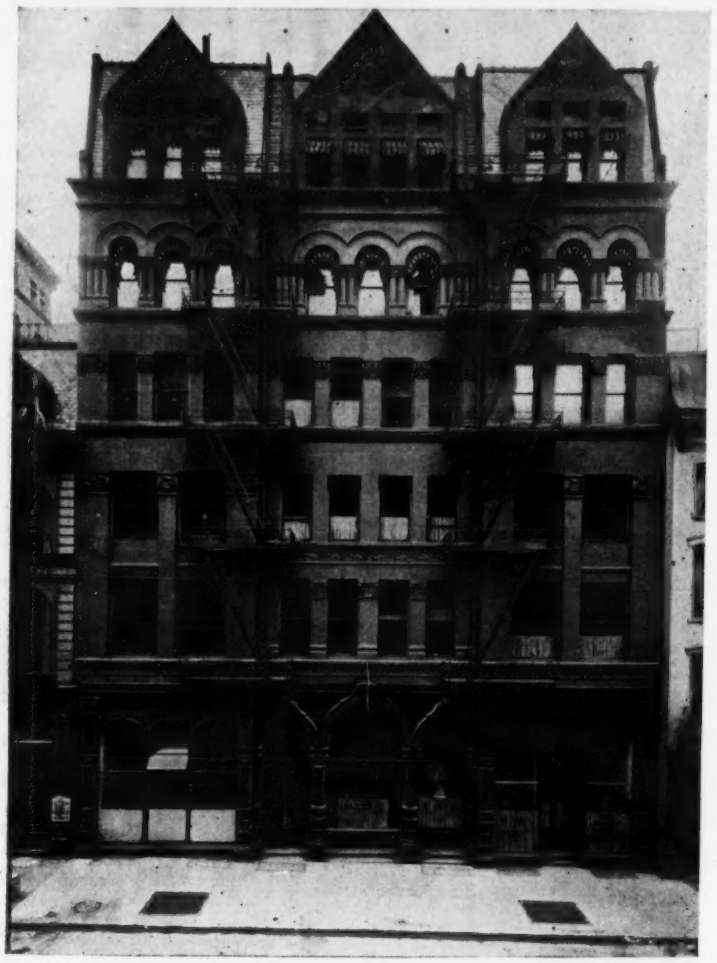


FIG. 1.—MAIN EXCHANGE, SAN FRANCISCO.

phone development and usefulness exceeding that of any other portion of the United States, certainly speak for themselves. It is not easy to state in a few words, nor is it always easy to determine, the exact reasons for the success of a business undertaking. The men themselves who have been responsible for the success cannot always give the reasons for it, and often when they do their opinions do not agree. The writer has talked with many telephone men on the Pacific Coast and elsewhere in the endeavor to determine the real factors which have made the Pacific Coast telephone business what it is. A number of different explanations have been given. Probably no one of them covers the case entirely. Taken together, they explain the case rather fully. Perhaps the most comprehensive reason offered by any one was that given by the man who said "The reason for the success of the Pacific States Telephone & Telegraph Company is its president." To know the policy and personality of President John I. Sabin is to know much of the secret of the company's success. Mr. Sabin is a man of unlimited energy and push, the dominant spirit of the whole undertaking and one who stops at no radical move that gives promise of making the telephone more popular and useful and increasing the business.

Going more into detail, the reasons for such a wonderful telephonic development as given by various people are as follows:

1. Faith in the unlimited possibilities and future of the telephone by the company, rather than the conservative belief that the developmentment possible was limited, that formerly prevailed in the East.

2. Giving the different classes of patrons, both local and long distance, various classes of service, suited to their needs.

3. The nickel-in-the-slot party-line telephone suited to the use of a large class of people.

4. Constant, active pushing for new business by solicitors and by advertising.

5. The use of exchange apparatus and methods suited to the enlargement of the business without great complication and expense.

The meaning of these reasons will be better understood later on when the methods pursued are taken up in detail.

SUBSCRIBERS AND POPULATION.

Statistics are apt to be dry, but in view of the high percentage of telephone subscribers to population most of the following figures will be of considerable interest to those familiar with similar figures on the use of the telephone elsewhere. The population and percentage of subscribers to population is shown in the following table:

PERCENTAGE OF TELEPHONES TO POPULATION, ACCORDING TO CENSUS OF 1900, IN EXCHANGES OF 300 OR MORE SUBSCRIBERS, AS AT DEC. 31, 1900.

Exchange.	Population.	Subscribers.	Percentage of subscribers to population.
SanFrancisco	342,742	21,324	6.22
Los Angeles	102,479	7,830	7.64
Oakland	96,638	6,560	6.78
Portland	90,426	6,445	7.12
Seattle	80,671	4,337	5.37
Tacoma	37,714	2,558	6.78
Spokane	36,848	3,618	9.81
Sacramento	29,282	2,257	7.70
San Jose	25,150	3,069	12.20
San Diego	17,700	1,359	7.67
Stockton	17,506	1,581	9.03
Fresno	12,470	1,405	11.26
Walla Walla	10,049	598	5.95
Pasadena	9,117	600	6.58
Astoria	8,381	363	4.33
Riverside	7,973	376	4.71
Everett	7,838	449	5.72
Tucson	7,531	352	4.67
Eureka	7,327	582	7.94
Whatcom	6,833	432	6.32
Santa Rosa	6,673	347	5.20
Baker City	6,663	408	6.12
San Bernardino	6,150	315	5.12
Santa Barbara	6,587	412	6.25
Santa Cruz	5,059	367	6.48
Phoenix	5,544	457	8.24
Bakersfield	4,836	656	13.56
Marysville	3,397	311	9.15

The two exchanges having the highest percentages are those at San Jose and Bakersfield. The figures in those cases are perhaps

FIG. 2.—WEST EXCHANGE, SAN FRANCISCO.

rather deceiving, however, for neighboring towns and suburban line subscribers are connected on the main exchanges. In the case of Bakersfield also the oil boom which is there in full force has something to do with the large number of subscribers. Aside from these considerations, however, the percentage is very high not only in those two towns, but in all the others. Independent exchanges are

in operation at Portland and Sacramento, and there was one formerly at San Jose.

The growth of the business in the company's territory from 1895 to 1900 was as follows:

Dec. 31.	Number subscribers.	Increase over previous year.
1895	20,053	....
1896	24,961	4,908
1897	34,511	9,550
1898	44,985	10,474
1899	64,538	19,553
1900	85,744	21,206

FIG. 3.—SUPPLY DEPARTMENT, LOS ANGELES.

In the city of San Francisco (the largest exchange) the same figures for the five years were as follows:

Dec. 31.	Number subscribers.	Increase over previous year
1895	6,372	....
1896	7,810	1,438
1897	11,374	3,564
1898	13,053	1,679
1899	16,817	3,764
1900	21,324	4,507

On Jan. 31 there were 21,755 subscribers in San Francisco.

CLASSES OF SERVICE OFFERED AND RATES.

The kinds of service offered to the public have an important bearing on the telephone growth in these States. The policy of this company is to suit the service offered as nearly as possible to the needs of all classes of possible subscribers rather than force all subscribers

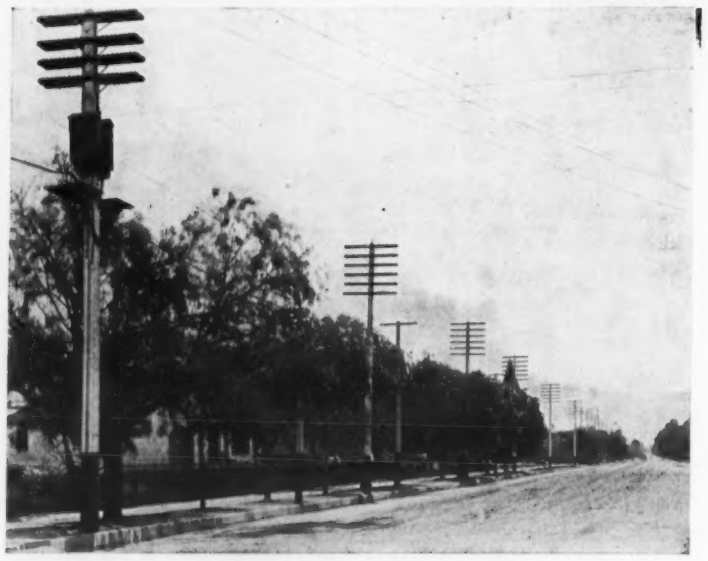


FIG. 4.—POLE LINE, LOS ANGELES.

to adapt themselves to one or two classes of service. The idea is to get something that will suit every one's pocketbook and requirements, rather than to try to convince a prospective customer that he wants something he does not need. The importance of suiting the service to the subscriber rather than the subscriber to the service is often not sufficiently realized by companies operating in other parts of the United States. There has been a conservative fear about adopting anything new because of the complications involved, or a fear that it would result in unsatisfactory service. The officers of the Pacific States Company have never hesitated to make a move on this account, and while the quality of service may have suffered sometimes as a result for short periods, the business has certainly been wonderfully built up. Then, too, the switchboard construction universally used on the Pacific Coast permits additions and changes to be made more easily than the multiple board construction which is common in the East. Of this aspect of the case more will be said later in connection with exchange equipment.

In the city of San Francisco the number of different classes of service offered make a rather formidable list. In the other cities the variety is not so great. The rate for a business or professional individual metallic circuit is $7.50 per month. Measured service on individual metallic circuit is offered by the following schedule:

Switches, or less, Per Month.	Per Month.	Extra Switches, each.
83	$2.50	4c.
166	5.00	3c.
250	7.00	2c.
416	10.00	1½c.
583	12.50	1c.

Nickel-in-the-slot telephones on a two-party line are put in upon a guarantee of 20 cents per day for business or professional use. If

FIG. 5.—LOS ANGELES EXCHANGE.

the earnings of the instrument in nickels falls below an average of 20 cents per day the subscriber makes up the deficiency. Nickel-in-the-slot telephones on 10-party lines for business or professional use are put in on a guarantee of 5 cents per day. Ten-party business telephones are put in on a rental of $2.50 per month, 40 switches free and 5 cents each above 40 switches.

Residence telephones on individual metallic circuits, unlimited switching, are $5.50 per month, and on a two-party line $5 per month. Nickel-in-the-slot instruments on two-party lines are put in residences upon a guarantee of 10 cents a day and on 10-party lines are put in upon a guarantee of 5 cents a day.

Of the 21,324 subscribers in the San Francisco exchanges, Dec. 31, 1900, there were 9,969 nickel-in-the-slot telephones of the various classes connected. While the nickel-in-the-slot 10-party line service is not suited to any one having much business over the telephone on account of the liability of frequently finding the line busy, it meets the needs of a large class of people and at the same time educates people to the use of the telephone, so that in case the 10-party service is not sufficient they take something better. Of the 9,969 nickel telephones, 482 were on two-party lines with 20 cents a day guarantee; 1134 were on two-party lines, with 10 cents a day guarantee; 3781 were on 10-party business lines, with 5 cents a day guarantee, and 4572 were on 10-party residence lines with 5 cents a day guarantee.

The nickel-in-the-slot service went into effect on the Pacific Coast

first about April 1893, and the express system was introduced first about December, 1892.

FIG. 6.—SAN JOSE EXCHANGE.

In some of the fairly representative cities outside of San Francisco the rates are as shown by the following table. The population

FIG. 7.—SEATTLE EXCHANGE.

and number of subscribers in the towns on this list can be obtained from the table previously given:

BUSINESS RATES.

	Individual.			Two Party.		Ten Party.
	Unlimited.	*100 Calls.	*40 Calls.	Unlimited.	*40 Calls.	*40 Calls.
Los Angeles	8.00	6.00	5.00	5.00	3.50	2.50
Fresno	5.00	....	....	3.50	....	2.00†
San Jose	6.00	5.00	4.50	3.50	....	2.00†
Bakersfield	4.00	....	....	3.00	....	1.50†
Stockton	6.00	5.00	4.50	3.50	....	2.00†
Portland	8.00	6.00	5.00	5.00	"X"	"V"

RESIDENCE RATES.

	Individual. Unlimited.	Two Party. Unlimited.	Ten Party. Unlimited.
Los Angeles	4.50	2.50	1.25
Fresno	4.50	2.50	1.25
San Jose	4.50	2.50	1.25
Bakersfield	4.00	2.50	1.25
Stockton	4.50	2.50	1.25
Portland	4.50	2.50	1.25

Outside of San Francisco, coin attachment or nickel-in-the-slot instruments are not used to any large extent, although there are 1879 in Los Angeles and 1498 in Portland.

A special class of service called "Business Exchange" has been installed in San Francisco and Los Angeles. This will be described under exchange equipment and operation.

LONG-DISTANCE RATES.

The main difference between this company's practice in regard to long-distance tariffs and others is the introduction of low rates for very short conversations. Connections will be made for anything from one-quarter minute up. Time is kept with a stop watch by the long-distance operator. The rates for various lengths of conversation are shown by the accompanying rate table. The rate numbers

LONG DISTANCE TELEPHONE TARIFFS.

Rate	¼ Min.	½ Min.	¾ Min.	1 Min.	3 Min.	†5 cents each add'l.	REMARKS.
1	....	....	....	....	.25	30 Sec.	†The additional 5-cent or 10-cent rate applies only after the longest period for which rate is given in previous columns.
2	....	....	....	.25	....	30 "	
3	....	.25	....	.40	....	30 "	
4	....	....	....	.40	....	30 "	
5	....	....	....	.50	....	30 "	
6	....	....	....	.50	....	20 "	
7	....	....	....	.50	....	15 "	
8	....	....	....	.50	....	10 "	
9	....	.40	....	.75	....	15 "	
10	....	.50	....	1.00	....	15 "	
11	....	.50	.75	1.00	....	10 "	
12	.50	.75	1.00	1.25	....	10 "	
13	.50	.75	1.00	1.25	....	5 "	
14	.50	1.00	1.25	1.50	....	3 "	
15	.50	1.00	1.50	1.75	....	3 "	
16	.50	1.00	1.50	2.00	....	3 "	
17	....	1.25	1.75	2.25	....	2 "	
18	....	....	....	....	.10	60 "	
19	....	....	....	....	.15	60 "	
20	....	....	....	....	.50	30 "	
21	....	....	....	.15	....	60 "	
22	....	....	....	....	.25	60 "	
23	....	....	....	.20	....	60 "	
24	....	....	....	.25	....	60 "	
25	....	.25	....	.30	.40	30 "	..2 Min. 35 Cts.
26	....	.25	....	.35	....	30 "	
27	....	.25	....	.40	....	30 "	{ 40 Sec. 30 Cts. { 50 Sec. 35 Cts.
28	....	.25	....	....	....	30 "	
29	.25	.35	....	....	....	30 "	
30	....	.50	.75	1.00	....	5 "	
31	....	....	....	.75	....	15 "	
32	.50	.75	1.00	1.25	....	4 "	
33	.75	1.25	1.75	2.25	....	2 "	
34	.75	1.50	2.00	2.50	....	2 "	
35	1.00	1.75	2.50	3.00	....	2 "	
36	1.25	2.00	2.75	3.50	....	....	{ 10 Cts. for each { additional 3 Sec.
37	1.50	2.00	2.75	3.50	....	....	{ 10 Cts. for each { additional 3 Sec.
38	1.75	2.50	3.25	4.00	....	....	{ 10 Cts for each { additional 3 Sec.
39	....	....	....	.10	....	60 "	
40	....	.50	.75	1.00	....	....	{ 10 Cts. for each { additional 15 Sec
105	....	.25	....	.50	....	30 "	
106	....	.25	....	.50	....	20 "	
107	.25	.35	....	.50	....	15 "	
109	.25	.40	....	.75	....	15 "	
110	.25	.50	....	1.00	....	15 "	
111	.25	.50	.75	1.00	....	10 "	

refer to a certain list of towns, and the rates are from San Francisco to those towns. The one-quarter-minute rate to Portland from San Francisco is 75 cents, and the rate to Los Angeles 50 cents. Portland is 772 miles by rail and Los Angeles 482. The short conversation rates catch much business that would otherwise go by telegraph.

*Excess switching at rate of 2c. each.
†No nickel machines connected; practically have unlimited service.
X.—No rental; 5c. a switch, subscriber guarantees 10c. a day.
V.—No rental; 5c. a switch, subscriber guarantees 5c. a day.

Introducing the Trolley at Huddersfield, England.

ALTHOUGH activity in planning for trolley development was seen in England a year or two ago, it was predicted by many observers that the work would be very slowly done, owing to the natural and artificial obstacles thrown in the way of the promoters. This has not been the case, however, one reason being that the municipal authorities who are usually prompt with obstructions have themselves taken up the trolley movement or have been constrained by public opinion into adoption of the new system. One of the progressive municipal bodies is the corporation of Huddersfield, which beginning with horses in 1882, on 10 miles of track, changed to steam in 1893, and with a system of 28 miles in 1898 has now developed a borough and rural network of over 50 miles. We are glad to have the opportunity to illustrate the system, exemplifying, as it does, a combination of the best English and American ideas and materials. In the power plant, which is illustrated herewith, the boiler room is 157 by 59 ft. and 23 ft. high, providing space for 8 boilers, of which 3 of the Lancashire type have already been installed. The furnaces are fitted with Vicar's stokers, with special clinkering nozzles that enable the clinker to be broken while the boilers are working. The conveying and feeding mechanism is run by a Greenwood & Batley 10-hp motor. Each boiler is fitted with a Green economizer, and a Musgrave superheater, and there are two Blake & Knowles pumps, each capable of supplying 3000 gallons per hour. All the steam piping is in duplicate. Adjoining the boiler house is the engine room, 130 by 42.6 ft. and 35 ft. high in the body. There are also large car sheds, built entirely of steel.

There are now installed two vertical inverted cross-compound condensing engines, manufactured by Musgrave & Sons, of Bolton. The high-pressure cylinder is 17½ inches in diameter, the low-pressure 35 inches, with 3-ft. stroke. The engines are rated for 520 ihp, with a maximum of 650 ihp at 90 r. p. m. and 150 lbs. steam pressure. They are fitted with Musgrave automatic cut-off gear, and are designed for working condensing or non-condensing. They are provided with adjustable forced lubrication, and all the parts are supplied by two ram pumps on each side of the engine. One pump is coupled to the neck and eccentric rings, the other to the crank-pin, crosshead-pin and side block; but, if necessary, both pumps can be coupled to pump the oil through one main pipe to the various parts. The valves are of the Corliss type, double ported, the high pressure only being coupled to the governor, which can be regulated to vary the speed while running. The flywheel is 18 ft. diameter, with 10 tons of metal in the rim. On starting up, an auxiliary engine is employed to "bar it round," the barring engine making 1055 revolutions to one of the main engine, and is fitted with automatic throw-off gear. The air-pump is 24 inches in diameter, with 14-inch stroke, the suction pipe dipping into an open culvert which runs the full length of the engine house in the basement. The condensers are of the injector type, giving a vacuum of from 26 to 27 inches, and

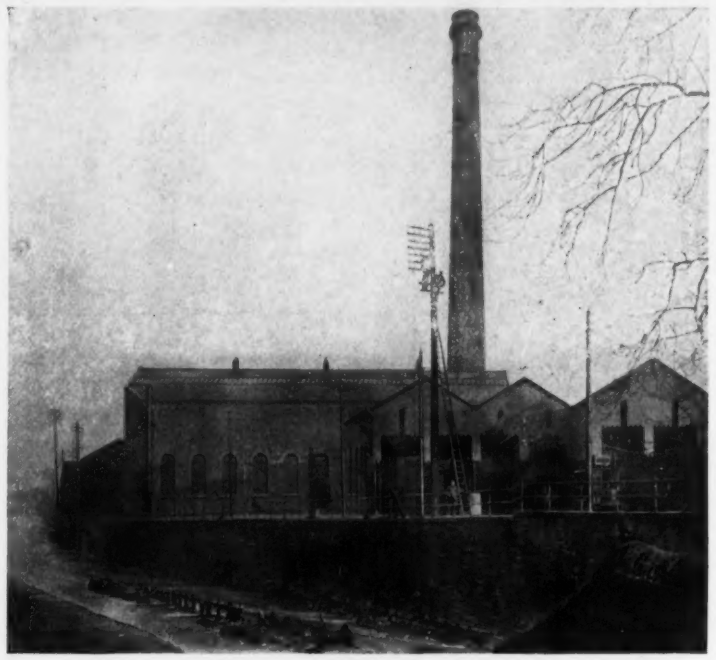


FIG. 2.—POWER HOUSE ON THE COLNE.

the injection water return pipes are laid alongside of the exhaust steam pipes at the top of the culvert, and discharge to the Colne River at a lower level than the intake, the whole arrangement being made sufficiently large for a total flow of 3000 gallons per minute when the station is completed.

The dynamos are Greenwood & Batley multipolars, over-compounded, the pressure being 500 volts at no load and 550 at 375 kilowatts. The armatures have slotted cores, and are internally ventila-

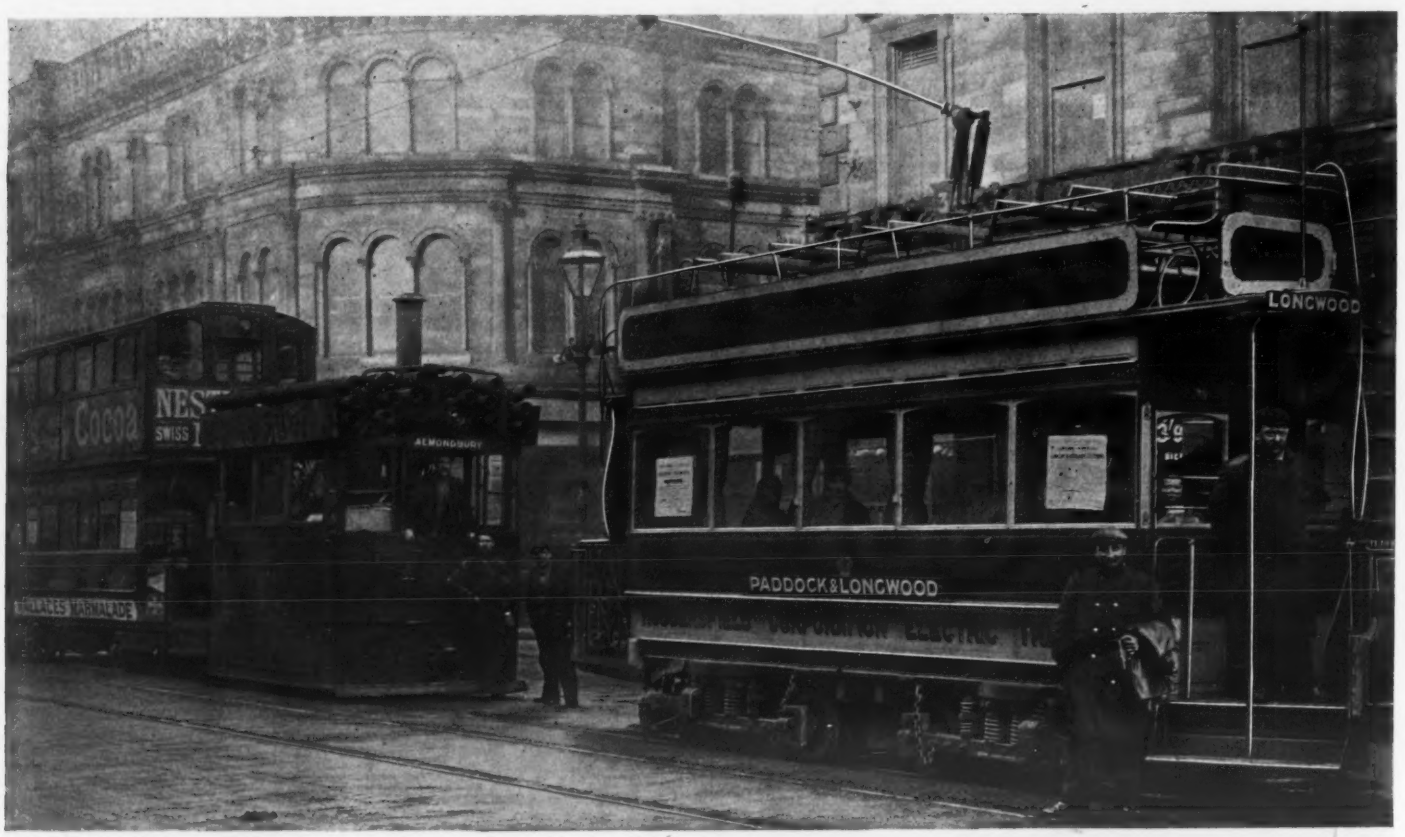


FIG. 1.—THE OLD AND THE NEW.

ted, with barrel winding, in parallel, the conductors being laid in slots with micanite trough protection. The armature is mounted directly on the engine shaft, the armature hub being bolted direct to the flywheel. There is also a General Electric 25-kw direct-coupled set, supplied by the British Thomson-Houston Company, used for the station lighting and for shunting around the car barn.

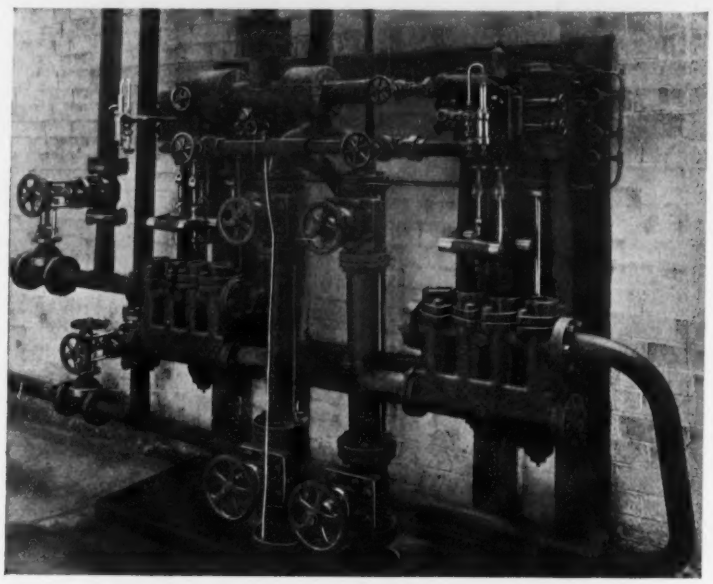


FIG. 3.—POWER PLANT FEED PUMP.

The switchboard, built by the British Thomson-Houston Company, is situated in a gallery which connects on the upper decks of the engines. The board comprises two generator panels, three feeder panels, a Board of Trade and a station lighting panel, and is made of enameled slate.

The line material was furnished by the British Thomson-Houston Company and Robert W. Blackwell & Co. The trolley wire is No.

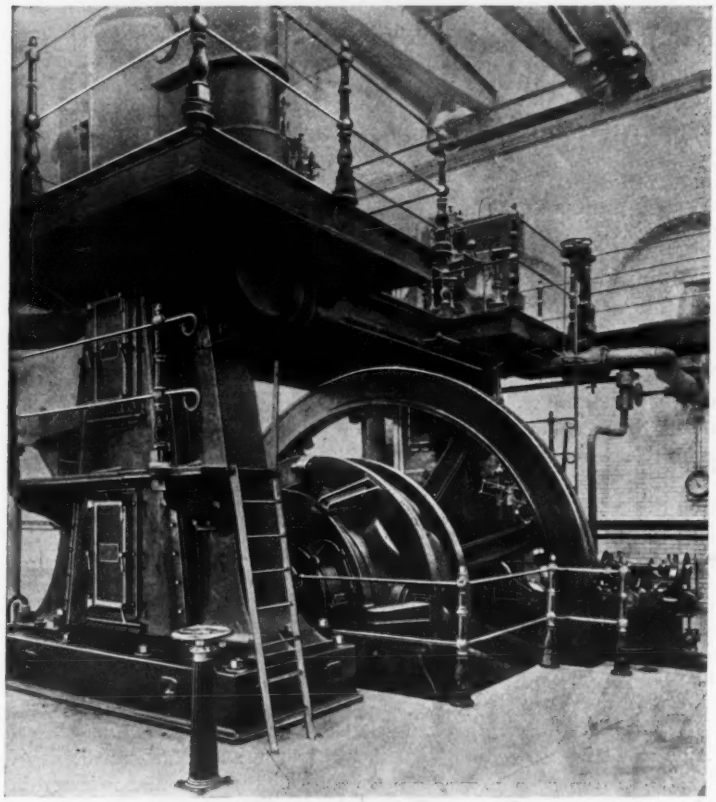


FIG. 4.—GENERATING UNIT, HUDDERSFIELD.

00 B. & S., and the poles are tubular steel. Paper insulated feeders are used, and they are laid in earthenware conduit bedded in cement, all being of English manufacture. The track is jointed with double 0000 Felten & Guilleaume bonds. The maximum drop between feeding points and the furthest point on the line is not more than 20 volts. The maximum drop on the rails in the town is about 3½ volts, and on the outlying routes not quite 5 volts, the leakage current being about one-fifth of an ampere. Section boxes are fixed about half a mile apart, with switches for cutting out any section, and two main switches for disconnecting rail and line feeder. Telephone cables are brought up to cast-iron boxes fixed to the feeder pillar, and each motorman carries a telephone of Western Electric make. The cars number 25, of which 16 are at present running. They were built by Messrs. G. F. Milnes & Co., of Hadley, and are mounted upon Brill maximum traction trucks. They are 29 ft. in total length, and carry 24 passengers inside and 33 outside. They carry each two G. E. 58 motors. The service in the town is every 10 minutes, and outside every 20 minutes. The postal authorities pay $1,500 a year for the privilege of using the cars for postmen and telegraph messengers.

Mechanical Equivalent of Light.

By Carl Hering.

EXPERIMENTS recently made with an arc light which departs entirely from the principles common to all those heretofore used, are claimed to have shown an efficiency of 100 per cent in the conversion of electric energy into light; that is, all the energy of current is claimed to have been converted into light.[1] That this cannot be correct, and that certain unallowable assumptions were made, will appear to those who have followed the description of the experiments, but it again brings up the question of the mechanical equivalent of light, what it is, and how it is determined. In view, therefore, of the fact that this novel, efficient and interesting lamp, although still of doubtful commercial value, may be experimented with by others, it may be of interest here to discuss the determinations of this mechanical equivalent of light made some years ago by Tumlirz and by Thomsen, and to reduce them to more convenient terms.

This mechanical equivalent of light, that is, the energy which is required to produce a unit quantity of light rays, is a figure not found in text books, and has heretofore been of comparatively little interest, for the reason that the best efficiencies which have been obtained in commercial lights have been so very low, that it was of little consequence to know how near the maximum possible efficiency they were. It sufficed to know that a really efficient commercial light was still unknown.

Another reason why this figure is not generally stated may be that it does not exist. There is no doubt that light is energy, since it is a form of vibration; if proof is necessary, it is found in the fact that light may be and often is converted into heat, as shown, for instance, by laying a black cloth in the sunlight, which will change the light into heat and get much warmer than a white cloth, which reflects it. Much and perhaps all of the heat we receive from the sun is conveyed to us as light or something similar, which is then converted into heat on or around the earth. Moreover, light is known to be nothing more than electromagnetic waves, precisely of the same kind as the Hertzian waves used in wireless telegraphy, the only difference being that the wave lengths are very much shorter than those of the latter. The shortest electromagnetic waves of the Hertzian order which it has been possible to produce, are a few centimeters long, while the lengths of the light rays are only one or two hundred-thousandths of an inch. According to Lord Kelvin, the period of vibration, or frequency, as we now term it, of light waves is between one four million-millionths of a second and one eight hundred million-millionths of a second. That Hertzian electromagnetic waves are a form of energy was shown by Hertz himself in an experiment in which he absorbed these waves by an apparatus in which they were converted into heat, which then manifested itself in the form of a deflection of the instrument, thereby indicating the presence of these invisible waves. Further proof is, therefore, not needed to show that light is a form of energy; nevertheless, there may not be a single mechanical equivalent of light, as there is for heat, because it may depend greatly on the color or composition of the light, that is, on the wave length, and there may, therefore, be a large number of different mechanical equivalents of light.

Nevertheless, it may be possible to determine an average value for the standard of light ordinarily used, and this is what Tumlirz endeavored to do. His experiments and those of Thomsen are the only determinations of this constant that the writer has been able to find

[1] Digest, March 9, p. 413.

in a hasty search. The former are described in three very long papers published in the Transactions of the Vienna Academy of Sciences in 1888 and 1889.[2]

In the first one he describes experiments with a platinum wire heated to a white heat by means of an electric current. He measured the radiation by means of an air thermometer especially constructed for this purpose, and also the total input of energy, from which he calculated the energy of the light. Taking the Hefner amyl-acetate lamp as a basis, he found that for the unit candle-power there is radiated per second as light, an amount of energy equal to 0.00326 gram-calories, or about 140 gram-centimeters, which reduced to electrical terms is about 0.0135 watt. He admits, however, that this is only a very rough approximation, and merely gives a general idea of this constant. His other determinations are better.

In the second paper he calculated a value of this mechanical equivalent of light from some earlier experiments of Julius Thomsen.[3] These are based on a unit of light consisting of a spermaceti candle consuming 8.2 grams of spermaceti per hour. The action of the light on a thermopile was compared with that of a glass sphere filled with water at 50 degs. C., the radiation from which was calculated by Thomsen according to the Dulong formula. The result of Tumlirz's calculation was as follows: The amount of energy in the form of light which falls per second on a vertical surface of 1 square centimeter at a horizontal distance of 1 meter from the center of this flame, is equal to 5.6×10^{-7} gram-calories. This reduced to electrical terms is 2.32×10^{-6} watts. Or in units of work, 0.024 gram-centimeters per second, or 2.4×10^{-7} kilogram-meters per second. These data will be discussed below, in connection with the reference to the original paper of Thomsen.

The third part of the Tumlirz article is the more interesting as it gives the results in definite and well-known terms. In this determination he measured, by means of a specially constructed air thermometer, the total radiation from a Hefner amyl-acetate lamp, including both heat and light, and then by means of a thermopile, the relation between the light rays and the total rays. From these two he determined the mechanical equivalent of light and obtained the figure 0.00361 gram-calories per second, for the energy of the light emitted in a unit solid angle in a horizontal direction. The exact definition which he gives is somewhat encumbered by mathematical expressions and conceptions, but such accuracy in definition is hardly warranted by the possible accuracy of the experimental determination. The above is what he means, and it agrees with the results in the next paragraph.

He furthermore states that the amount of energy in the form of light which falls per second on a vertical surface 1 square centimeter at a horizontal distance of 1 meter from the center of the flame, is equal to 361×10^{-9} gram-calories, or "$(1.226 \text{ milliamperes})^2 \times 1$ ohm." Assuming that a unit solid angle is one which at unit radius subtends a unit surface, and which, therefore, at one meter radius would subtend 10,000 square centimeters, the latter figure agrees with the statement in the preceding paragraph.

These figures may be reduced to the following forms, some of which may be more convenient than those given by Tumlirz. They are all based on the Hefner amylacetate lamp as the unit of candle-power, and should there be a difference in the mechanical equivalents of light for sources of different color, then the present figures are limited to the color of that particular flame. Attention may here be called to the fact that while the mechanical equivalent of heat is expressed in terms of units of work, such as foot-pounds or joules, the mechanical equivalent of light is expressed in units of power, such as horse-power or watts. Either may be, of course, reduced to the other by introducing a limited time.

The amount of energy in the form of light which falls on a vertical surface of 1 square centimeter at a horizontal distance of 1 meter from the center of the flame, being taken, according to Tumlirz, as 361×10^{-9} gram-calories in each second, then, if expressed in units of power, as it should be, it is equal to 2.01×10^{-9} horse-power (English), or 1.50×10^{-6} watts. Or, if expressed in units of heat or work in a limited time, it is equal per second to 3.61×10^{-10} kilogram-calories, or 1.53×10^{-7} kilogram-meters, or 1.105×10^{-6} foot-pounds, or 1.50×10^{-6} joules.

An illumination of a meter-candle is that produced on a surface normal to the rays, by a standard candle at the distance of one meter. The above figures, therefore, also represent the power in the light per square centimeter on an illuminated surface for each meter-candle of illumination. A room $12 \times 15 \times 9$ ft., which is lighted so that the illumination which reaches the walls, ceiling, floor, is equal to about 10 meter-candles—which is quite a bright illumination and enables fine print to be read with ease—would, therefore, require only 11.8 watts for light, if the efficiency were 100 per cent, or less than a quarter of the power in a single ordinary 16-cp electric lamp. There is, therefore, room for improvement if the basis of these figures is correct.

All the above figures refer to the surface which is illuminated, and not to the source of light. To calculate all the power which emanates as light from a source, it is necessary to know the mean spherical candle-power of the source, or the relation of this to the candle-power in the direction in which the light was measured. The figure can, however, be determined as follows for a unit spherical candle-power—that is, for a source which emits one candle-power in every direction, or whose average spherical candle-power is unity.

The original data were based on the amount of light in a unit solid angle. If this unit is the solid angle subtended by the unit surface at unit radius, then a complete sphere measures 4π or 12.57 solid angles in terms of that unit. This, multiplied by Tumlirz's figure for the unit solid angle, .00361 gives .0454 gram-calories per second per spherical candle. This is equal to 2.52×10^{-4} horse-power, or 0.188 watts; or, in terms of units of heat or work per second, to 4.54×10^{-5} kilogram-calories, or 0.0193 kilogram-meters, or 0.139 foot-pounds, or 0.188 joules. One horse-power could, therefore, produce about 4000 spherical candle-power, or 8000 hemispherical candle-power.

According to these figures (if the Tumlirz constant is correct), the maximum light efficiency obtainable would be about 0.188 watts per spherical candle, which corresponds to about 5.3 candles per watt, and in this form the mechanical equivalent of light given by Tumlirz may be compared directly with our present way of stating the efficiency of electric lights. If we assume the mean spherical candle-power of an arc lamp to be 1 watt per candle, the light efficiency based on the Tumlirz constant would be about 19 per cent. That of the Nernst lamp at 1.5 watts per candle would be about 13 per cent; that of incandescent lamps at 2.5 watts per candle about 7.5 per cent, or at 3 watts per candle about 6.3 per cent.

Tumlirz made a deduction from his determination which, though of no utility, is at least interesting. If one looks at a standard candle from a distance of 1 meter, and if the pupil has a diameter of 3 mm, the energy entering the eye per second as light is so small, that it would require 1 year and 89 days to heat one gram of water 1 deg. C. A more interesting figure would have been the power in watts or horse-power which is consumed in the eye when one looks directly at the sun.

Unfortunately, the Tumlirz determination was based on taking the difference or the ratio of two measured quantities which are nearly alike. This is a method which should not be resorted to unless there is no better way, because a very slight error in either of the two measurements produces a very great error in the calculated quantity sought. His results are, therefore, probably not very accurate. A better way to determine this constant, or constants if there are several, would seem to be to use a source of cold light, such as that produced by phosphorescence or vacuum tubes, convert a known part of it into heat and then measure this heat. Or, to use an ordinary source of light and filter out the heat rays (if any means for complete filtration exist), and then convert the cold light rays into heat which can be measured, as Thomsen did. The quantity desired will then be measured as a whole, and not as a difference between two measurements which are nearly alike, and the error would then be much less if no new sources of inaccuracy are introduced thereby.

Very little seems to have been published on this subject of the mechanical equivalent of light, but it may be of interest to compare a few other figures which have come to the notice of the writer.

The *Philosophical Magazine* of 1865, vol. 30, series 4, p. 429, contains an article by Julius Thomsen on the mechanical equivalent of light, and it appears to be the same one to which Tumlirz referred in his second paper. The method used was to measure by means of a thermopile the total radiation (heat and light) from a spermaceti candle burning 8.2 grams per hour (this measurement does not seem to enter into the calculation); he then measured that part due to the light alone, by absorbing the heat rays in a layer of 20 cm of water, which he says completely absorbed them. The readings of the thermopile were calibrated by using a bulb of warm water in place of the lamp, the heat radiation of which could be calculated

[2] Tumlirz Sitzungsbericht der Wiener Akademie der Wissenschaften, 1888, XCVII, II, p. 1523; same volume, p. 1627; and 1889, XCVIII, II, p. 826.

[3] *Poggendorf Annalen*, 125, p. 348.

from Dulong's law. He thus finds that 1 kilogram-meter in a second is equal to 34.9 times the energy of the luminous rays from a spermaceti candle burning 8.2 grams per hour. He adds, "This is the maximum of the mechanical equivalent of light, and it may possibly still be somewhat reduced by subsequent experiments."

Thomsen refers to this as the "radiation" from such a flame, and gives no limiting boundaries. It may, therefore, be assumed that this figure is for the total radiation in all directions, if this radiation in every direction is equal to that in the direction in which he measured it. In other words, the result then refers to a unit spherical candle-power, whether the ratio of the spherical to the horizontal for that flame was unity or not. Tumlirz in his deductions from Thomsen's figures makes this same assumption, as calculations will show.

With this assumption, about which there is little doubt, these figures may be compared directly with those of Tumlirz. The candle used by Thomsen was apparently the British standard, which consumes 120 grains, while 8.2 grams would be 126.5 grains. Correcting for this increased consumption, and for the ratio of the Hefner to the British unit, makes the Hefner unit equal to 0.83 of that used by Thomsen. Thomsen's mechanical equivalent reduced to spherical Hefner units then equals 0.236 watt as the power for one spherical Hefner candle. Tumlirz's corresponding figure is 0.188, showing a very fair agreement, considering the difficulties involved in the measurements, especially as Thomsen merely claims his figure to be the maximum value.

Professor Ebert, a well-known German physicist, is reported to have stated that a single horse-power would be sufficient to operate 46,000,000 Puluj lamps of 16 candle-power. This means 7.36×10^9 candles per horse-power. As that lamp consists of a piece of mica painted with sulphide of calcium and subjected to the action of cathode rays in a vacuum, it would not be correct to assume that this is expressed in spherical candle-powers. Let us suppose the spherical candle-power was only a tenth of the horizontal, which is surely favorable to his figure, it would then reduce to 7.36×10^7 spherical candles, while, according to Tumlirz, it would be only 4×10^3, which is only about one twenty-thousandth of Ebert's figure. The discrepancy is rather large, and if Ebert's figures are at all reliable, Tumlirz's mechanical equivalent of light is far too large.

H. Ebert, presumably the same physicist, in an article on Light from Electric Oscillations (see *Electrical World*, Nov. 3, 1894, p. 467), describes a "luminescent lamp," which gave one-thirtieth to one-fortieth of a Hefner candle and consumed about one-millionth of a watt, the latter being calculated, as he says it was too difficult to measure it directly. If this referred to spherical candle-power the mechanical equivalent for a spherical candle would be 0.00003 to 0.00004 watt, as compared with Tumlirz's figure, 0.188. The difference is again very great. Judging from the illustration of that lamp the spherical candle-power may have been about one-eighth of the horizontal, which would make his figure 0.00024 to 0.00032 watt.

Dr. Lodge, the distinguished English physicist, is reported to have said that at 100 per cent efficiency one man turning a crank could develop sufficient energy to light a whole city. Assuming a man-power to be one-eighth of a horse-power, he would, according to Tumlirz's figures, generate about 500 spherical candles, or 1000 hemispherical, which would not be a very brilliant illumination for a city. According to this, the Tumlirz equivalent is again much too great.

The new arc lamp referred to at the beginning of these notes is one recently described by Rasch,[4] in which the arc is produced between two electrodes of magnesia, or other similar material, usually an oxide, including some of those of the rare earths, which is rendered conducting by heat, as an electrolyte, like in the Nernst lamp. He found that the efficiency increased with the input, reaching a maximum at 5.21 Hefner amylacetate candles per watt, after which it diminished again, the electrodes then becoming liquid. This figure approaches very closely to the corresponding equivalent determined by Tumlirz, namely 5.3 candles per watt, which would indicate an efficiency of very nearly 100 per cent. The latter figure is, however, based on spherical candles, while Rasch seems to base his figure on the horizontal candle-power. The necessary correction might diminish this efficiency by nearly 50 per cent. The ideal lamp of 100 per cent efficiency has, therefore, not been reached by him, as he claims, although even when corrected his efficiency seems to be far above that of commercial lights, and his experiment is, therefore, of interest. Whether his lamp can be made commercial seems still very doubtful. But even if not, it may be of considerable scientific interest in connection with the theory of the arc lamp. That the efficiency could not be 100 per cent as claimed, is also evident from the fact that energy must be spent in volatilizing the electrodes, which are consumed, and considerable free heat is also developed, not only in the arc but in the electrodes as well. This must reduce the efficiency very greatly, for even if the Tumlirz equivalent is only approximate, it shows what has been generally known—that the mechanical equivalent of light is very small, or, in other words, that a small amount of heat or work corresponds to a large amount of light. Any light approaching an efficiency of 100 per cent must, therefore, be cool, if not very nearly at the surrounding temperature, and if it is not so, one may be sure even without a knowledge of the exact value of the mechanical equivalent of light, that the ultimate has not been reached.

[4] Electrical World and Engineer, March 9, 1901, p. 391. *Elektrotechnische Zeitschrift*, Feb. 14, 1901, p. 155. See also the reply of Nernst, same journal, March 21, p. 256.

The Development of the Incandescent Light to 1880.

By A. E. Fay.

Possibly a few words in addition to Mr. Hammer's recent article with the above title may be of interest. As he described some platinum lamps, it seems that some of the experimenters in this line who came before Starr (1845), where Mr. Hammer's history begins, should be given some attention. It also seems that the attempts made by the early experimenters to find the proper medium with which to surround the incandescent body, and the results of their experiments, should form a part of a history of this subject.

The first to produce an electric light of any kind in vacuo was Hawkesbee, but as his was produced by induction, the best means at his disposal at that time, 1705, it has no bearing upon the modern light. As Mr. Hammer says, Davy first produced a brilliant light, in 1810, or earlier, by heating a piece of charcoal or a platinum wire by means of his great battery, and at he same time he discovered the fundamental principle of the arc light, and was the first to use a vacuum in connection with it, his purpose being merely to increase the length of the spark. The next step was to employ it to retard the combustion of the carbon electrodes, which was suggested by Meinake in 1821 (Colburn's "Practical Economy"), and was practiced by Deleuil and Archereau from 1841 to 1844.

The third and final step, that of placing the continuous conductor in vacuo, seems to have been invented by Starr, but de Changy has claimed that it was first suggested by Jobart, of Brussels, in 1838 (*La Lumiere Electrique*). His contentions regarding his and Jobart's early work in this line are open to grave doubts, however.

A peculiar lamp was invented by Frederick de Moleyns, of Cheltenham, England, in 1841, in which a helix of platinum wire was placed in contact at the end with a knob or a second helix in vacuo. The helix was heated to incandescence, and then the contact was broken, forming an arc. The brilliancy was to be increased by means of a stream of finely powdered carbon descending upon the arc. Although this was meant for an arc lamp, the fact that part of the light was caused by the incandescence of the platinum wire might make it an anticipation of that part of Starr's invention in which he used a strip of platinum in vacuo; but his carbon lamp was new and, as Mr. Hammer says, that was the real beginning of the history of the modern lamp.

A few months before the date of de Moleyns' invention, Prof. W. R. Grove had produced a steady light by the incandescence of a spiral of platinum wire in an enclosed, but not exhausted glass (*Phil. Mag.*, 1847); and Prof. Draper was engaged in experiments along this line at the time of Starr's invention (*Silliman's Journal*, 1847).

As to other media, Davy had found that ether, alcohol, oils, and water allowed his platinum wire to become only white hot with the same power that would fuse it in air (*Phil. Trans.*, 1821), while Grove found that if a platinum wire were heated to incandescence in air, it was apparently extinguished when enclosed in hydrogen, but that oxygen and nitrogen did not produce this effect (*Phil. Mag.*, 1845). He tried the effect of various gases and liquids, including the common hydro-carbons, on both platinum and iron wires (*Phil. Trans.*, 1848). About 1860 nitrogen, carbon dioxide, oxygen and carburetted and phosphoretted hydrogen were tried in this way, not as mere scientific experiments, but in actual lamps.

The first incandescent lamp to be patented in this country was

that of Gardiner and Blossom, brought out in 1858. It was the simplest form of the platinum helical coil lamp, and was designed for a marine signal lamp. No references were cited against the broad claim by the patent officials.

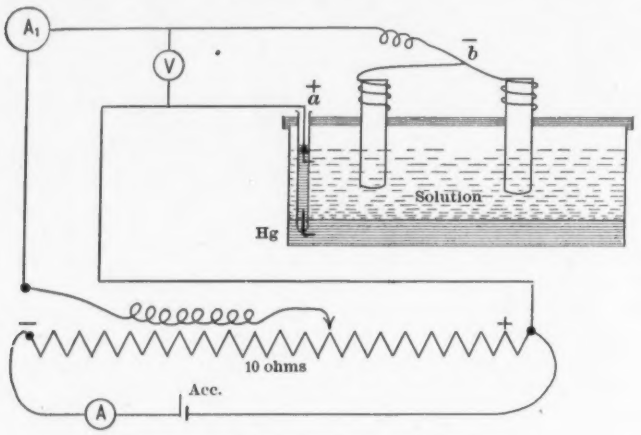
The Electrolytic Purification of Mercury.

By Woolsey McA. Johnson.

SOMETIME ago, while making an electro-chemical investigation at the Jarvis Physical Laboratory of Trinity College, Hartford, I had occasion to need some reliably pure mercury. As the distilling apparatus was not in order, I thought that it was a good occasion to put into execution a plan I had had in mind for some time for clearing mercury by electro-chemical means.

When we consider that the Ostwald process only depends on the fact that the "electrolytic solution pressure," or ionizing pressure of hydrogen is less than that of the impurities and greater than that of mercury, it seems very possible to assist the impurities into the solution of acid by the use of an electric current. By the proper arrangement of electric potential or voltage and the opposing pressure due to the changes produced in the solution by the current (variable at will by changing the resistance or the solution) we can regulate the process.

In order to regulate the drop, an accumulator of about 20 ampere-hour capacity was closed through a 10-ohm circuit. By a sliding contact, a shunt of varying ratio allows the voltage at the terminals *a, b* of the "purification-cell" to be varied at will. As the resistance of the cell was very small, any e. m. f. larger than the "polarization e. m. f." of the cell would shunt a current through the cell. For example, we will call this counter e. m. f. 1 volt, and the resistance of the cell 0.05 ohm. Then, if we place the shunt at 5



ELECTROLYTIC PURIFICATION OF MERCURY.

ohms corresponding to 0.975 volt (5/10 1.95 or ½ the accumulator voltage), no current will flow through the cell. When, however, the potential exceeds 1 volt, the current will shunt through the cell. At direct connection with the poles of the accumulator, the effective voltage is 1.95 — 1.00 = 0.95, and the current will be

$$\frac{0.95}{.05\,\times}\quad\left(\times = \text{the resistance of the accumulator}\right)$$

if we neglect the fact that there is always a second or even a third "polarization point" to any cell.

The mercury was of the usual purity and originally came in iron jars. It tarnished on exposure to the air and left a black smudge on porcelain. About a kilogram of this was poured into a flat crystallizing dish of 15 cm diameter, and covered with 500 ccs of a solution KNO_3 4 per cent HNO_3 17 per cent. Connection was made to the mercury as anode by a sealed platinum wire in a glass tube. The cathodes were two carbon rods, around which wire was wound to make a good connection. The scheme of connections was as described above. A voltmeter (*V*) and two ammeters, one (*a*) in the main and one *a* in the derived circuit, enabled the chemical actions to be diagnosed. At first we have a very large current due to the fact that the purifier is at first a cell of considerable e. m. f., and works with the current from the accumulator. But immediately a counter e. m. f. is set up. As long as the voltage is kept below 0.75 very little mercury will leave the anode, but the current rises as its carriers the pure active ions of Fn, Cd, Pb, Cu, etc. On the cathode, of course, hydrogen is evolved. To the voltage of polarization must be added the "casparische überspannung," or the pressure necessary to push the hydrogen ions through the pores of the carbon.

A glance at the Values of Wilsmore[1] for the "electrolytic potential" shows that for normal concentrations of the ions, all the ions of the strong metals and of all the weak metals excepting the noble metals would be pushed out into the solution easier than the mercury ions. The fact that the ionic concentration is low in the cell is balanced by the "casparische überspannung." Instead of the voltage of 0.75 a voltage of 1.00 can be used without sending very much mercury into the solution. After changing the solution several times the current can be broken and the solution poured off and the mercury dried.

$Zn = +\ 0.770$	$as > -\ 0.293$
$cd = +\ 0.420$	$Bi > -\ 0.391$
$P6 = +\ 0.148$	$sb > -\ 0.466$
$H = +\ 0.0$	$Hg = 6.750$
$cu = -\ 0.329$	$ag = -\ 0.771$

As a result of the current going for six hours the mercury was very mobile and left no discoloration on porcelain. Long times and small currents (about .03 ampere) gave the best results. If there had been any suspicions of silver as an impurity the addition of 0.1 per cent K Cl would have reduced the concentration of the + *bg* ions to such an extent that the mercury could be purified of the silver. As a matter of fact, traces of the noble metals (and their value assumes that only traces have been left), do not injure mercury at all for electro-chemical purposes.

I think that for laboratories, where a steady source of current is at hand, this method will give better results than the old method of allowing the mercury to drop through a long tube full of HNO_3. The apparatus is just as simple as the instruments could be dispensed with. At any rate, it is interesting from a scientific point of view, less wasteful of mercury and more efficient in the purification. An interesting extension of this would be the investigation of the rate at which amalgams of known composition are purified under varying condition of voltage, solution and temperature.

In conclusion, I would like to express my thanks to Dr. Riggs and Dr. Robb for their kindness in allowing me the use of apparatus and facilities of their laboratories in this and other experiments.

Power Transmission at Mexico City.

By C. R. Mundinger.

WHILE we in the United States are making rapid progress in power transmission work, our neighbor, the Latin American Republic, is by no means idle in this respect. It is a well-known fact that Mexico possesses many favorable locations for water-power plants, being generally very mountainous and having some very good water supplies; but not often can as perfect a location be had as that of the "Compania Explotodora la fuersa hydro-electrica de San Ildefonso," which company's five generating stations are strung out among the mountains from 12 to 30 kilometers to the northwest of Mexico City. Mexico, owing to the fact that the poorest grade of coal costs $22 and upward per ton there, is an ideal city for this kind of power. All the stations are now completed and in operation, except one. The machinery consists altogether of 19 waterwheels, made by Picard & Pictet, of Geneva, direct connected to as many 225-kw, two-phase, 50-cycle Westinghouse alternators. Step-up transformers change the 440 volts, two-phase, as it comes from the alternators, to 22,000 volts, three-phase, by means of the well-known "main and teaser" arrangement, commonly known as the Scott two-phase-three-phase system. Each plant is provided with two 125-volt exciters driven by Pelton wheels.

From Madin station (the nearest to the city) to Veronica station, the receiving station, a distance of about 12 kilometers, extend a wood and an iron pole line, each carrying three insulated wires. Here it may be stated that transmission lines in Mexico do not, as is the custom in the United States, employ bare copper wire, for the simple reason that the excess of duty on bare over insulated copper wire, somewhat exceeds the difference in first cost of the two. At Veronica station, which is situated in the western edge of

[1] *Zeit f. Phys. Chem.*, xxxv 3, p. 318.

Mexico City, the 22,000 volts is lowered to 2500 volts, at which pressure it is distributed about the city.

In the other direction from Madin station extend two iron pole lines, each carrying two sets of wires, viz., six in all. One takes a southwest direction, while the other extends almost due west. The end of the former is at Alameda station, where there are four generating units. The most interesting feature of this system lies in the fact that on both of these branches the same water is made to do its work three times before it is released. After the water at Alameda, which descends from the top of a mountain about 560 ft. above the station, through a 42-inch tube 1500 ft. long, passes through the wheels, it is conducted through a canal about 3½ ft. wide by 3½ ft. deep, which winds around the mountain sides (crossing intersecting ridges by means of tunnels, and ravines by bridges and iron "V" tubes, thereby avoiding the necessity of so much canal construction that would be needed to get around these objects) to Chiluca station, a distance of about 5 kilometers.

While at the start, at Alameda, the canal and river, or natural watercourse, are on a level, the canal is, because of its small drop and great drop of the river above, 250 ft. above the latter at Chiluca, where it drives three units. After meeting the river once more, the water is immediately caught up by another canal and by the same scheme of canal construction is at Madin station, 4 kilometers northeast, again about 145 ft. above the river. At Madin station are only two units. Here it is, after being used three times, turned loose in the natural course, and after flowing for a few miles to the northeast is mostly used up for irrigating purposes.

At Villada, about 18 kilometers west of Madin, on the other line, is a station equipped with five units working under a head of 430 ft. When discharged here, the water flows east for about 6 kilometers to Aquacaliente (this name is taken from two Spanish words, "aqua," meaning water, and caliente, meaning hot, there being a small hot spring there) where five more units are worked under a 395-ft. head. This is now all the stations which contribute to the Mexico City power, but when discharged here the water goes to Tlilan, where is another plant of two more units of 225 kilowatts, driven by Pelton wheels. The current from this station is sent to a large woolen mill about 5 kilometers away. The volume of water in this canal is somewhat greater than in the first mentioned, but in either the volume is very small; yet, owing to the comparatively high pressure at three of these stations, and taking advantage of the slope by using the water over so many times, it all goes to make more power than would be expected of such small rivers.

It is needless to say that all 19 alternators are run in parallel. The synchronizing is effected by means of the usual "dark lamp," and is done on the low-tension or generator switchboards. Some little trouble is occasionally experienced from short circuits, due to some mischievous natives who, for the want of better amusement, toss upon the line large green stalks of the soppy and green maguey plant, which is better fit to produce a sap from which pulque, mescal and other bad Mexican drinks are made, than to ornament a 22,000-volt transmission line. However, the sword-shaped leaves usually burn off in a short time, leaving the line clear. Natives, called "celadors," patrol these lines every day. On account of its quietness and apparent innocence it was difficult to impress upon the natives the extreme danger of the high-tension line, until, unfortunately, some were sent to the next world through its agency. The object lesson proved very beneficial to their more fortunate associates, and now they use every precaution that an "Americano" would when working near it.

This system will be reinforced by a most modern steam plant of 1500 horse-power situated on the site of the receiving station, as the water is more scarce during the extreme dry season. At the same place there will be a storage battery plant, which will help to equalize the load on the water power stations by being charged by means of "rotaries," at those hours of the day when the demand is small.

The switchboard apparatus is similar to that used in other plants of this kind, including time element circuit breakers and wood fuse circuit breakers for the high-tension boards. These are made of two pieces of wood. The shorter length is hinged at the center of the longer, which extends down about 3 ft. below the bottom clip to form a handle. The short length, which is the blade, is held against the action of a spring at the hinge by means of the fuse at the upper end, which, on melting, allows the shorter stick to swing on its hinge, thereby opening the circuit some 6 ft. The switches are detachable from the marble tablet on which are mounted the clips, 3 ft. apart, and must be fused before inserting, thereby avoiding all danger to the attendant.

The six stations, with dwelling houses attached for the attendants, are built of "tate tapa," a common building material in Mexico, with corrugated steel ceilings and granitard or cement roofs as flat as any pavement.

The system is equipped with a good telephone system connected upon the bridging principle. It is absolutely inter-communicating, and Madin, Chiluca and Alameda may converse over three different lines. The instruments are of the "Ericsson Swedish" type.

All electrical apparatus, machines, instruments, switchboards, etc., are of the Westinghouse make. The attendants of these stations are Americans, Mexicans and Spaniards. The installing of all the machinery was done by Bailey & Lawrence, a local contracting firm.

Telephone Service Ideals.

By G. F. Jenks.

WHEN the original Bell patents expired some years ago some of the Bell companies sold Bell telephones; that is, Bell receivers. This was done in a quiet way without advertising, and in some cases, although sales were made, the Bell companies would not make deliveries, but the buyers were obliged to carry home the receivers themselves. There was a comparatively slight demand for these telephones, largely because a receiver is ordinarily of no use without a transmitter, but some of these Bell receivers were used in connection with independent battery transmitters, and others were rigged up in pairs, so that one receiver would be used as a magneto transmitter. These lines, of course, were effective only over short distances and under the most favorable conditions, but such arrangements were used until recently, and some may still be in use on private lines.

At the time the receivers were sold, other equipment, such as magneto ringers and extension bells, could be procured from the Bell companies for use on private lines; but this has been mostly done away with, and in general the Bell companies have insisted on leasing all apparatus for private line work as well as for exchange service, although in private line work the "subscribers" are at liberty to provide their own wires. All this was while the Bell interests were preserving the fiction that they controlled all "battery" transmitters through the Berliner patent. Now that this theory is swept away, it may be profitable to speculate on what their position will be in the future.

The telephone ideal will only be reached when every business man has a telephone on his desk, when every house has a telephone in every room, and when all these telephones can readily communicate with each other. This ideal is approached in certain offices and hotels nowadays. Some of the installations are of Bell instruments and some are independent, but the Bell installations usually approach more nearly to the ideal because they are parts of the great Bell system which covers the whole country, while all of the independent installations are limited to a greater or less extent in the territory they cover, and many of them do not reach beyond the building in which they are installed and its immediate vicinity. It is a great disappointment when you have a telephone in your room in a hotel to find that it communicates only with the office, and that to make an engagement in town or get a report from your home office you must go down stairs and wait for your turn at the "pay station."

It is noticeable, too, that the quality of service in such isolated independent systems is frequently not reliable. This is especially the case when the telephones are bought outright, and is natural enough, for the average electrician of a hotel or business building can hardly be expected to inspect and care for a telephone system as well as the employees of a regular telephone company can. In the larger cities, then, the Bell companies are coming nearer the telephone ideal than are the independents.

In the smaller towns and in the country, matters are frequently reversed. The independents manage somehow to get a telephone into every house while the Bell telephones are used only where long-distance service is a necessity, and frequently are installed side by side with the independent telephones, for if you do not have the independent you cannot reach the neighbors. Here you are not so certain to get superior service from the Bell telephone as the instruments are so sparsely scattered through the country that they cannot receive the constant attention necessary for good telephone

service. There is present, too, a great waste in the duplication of wires and telephones, and that in parts of the country where such waste can be least afforded.

It may be said, then, that the nearest approach to the telephone ideal is given by the Bell companies in the largest cities, and the next approach is that of the independent companies in the rural communities, where "every one has a telephone," while the worst state is in the parts of the country where the Bell and the independents are in violent competition.

I have cited above the fact that when their first great patent ran out the Bell companies for a time made a great break with their traditions and sold telephone receivers. I cite this not to intimate that they may now be willing to sell telephone transmitters, but simply as an indication that it is possible that they may under present circumstances make a violent but shrewd reversal of their present policy if there is a prospect of their gaining by it. It seems possible that matters may be so handled that it may now be to the Bell companies' interest to help the public to reach the telephone ideal. That can hardly be attained by the selling of telephones as long as the majority of us do not know how to repair telephones and lines and to maintain telephone batteries, but if the Bell people will only consent to the shattering of another of their idols, a long step can be made.

This quickest step toward the ideal is to connect up Bell and independent systems by trunk wires, charging a proper toll for the use of these trunks. This is the system that works successfully in the City of Mexico. It is, to be sure, rather a question if it would work successfully here if too indiscriminately applied, as many independent transmitters are not adapted to long-distance service. They work successfully in local service with two or three volts, but they can hardly stand up in competition with the Bell solid-back that will not heat under a normal voltage of four to six running up to over twenty in central energy systems. This is a disadvantage in independent telephoning which has been pressed by the Bell interests for perhaps more than it is worth, for there are a numbr of independent transmitters in existence which compare favorably with the Bell even in such work, and if there were a demand for them, more could readily be developed. Further, there are few independent transmitters which are so hard to keep in adjustment or so bad for long-distance work as the old Blake transmitters which the Bell companies still supply for certain classes of service.

The independent companies would then have to provide suitable and well-cared for transmitters if they were allowed to connect with the Bell system of wires and telephones.

It is true that if the Bell companies agreed to such connection they would lose their detached subscribers in the territory "captured" by the independents, but the rates and divisions of the tolls could readily be so arranged that they would gain enough in tolls on calls interchanged with the independent systems to recoup their losses. They would also be saved entirely the expense which must be considerable, of keeping up the care and inspection of a large number of these unremunerative scattered wires and instruments. Indeed, it seems quite possible that they could enforce a standard of efficiency upon the independent companies which they do not always maintain themselves in their "thin" territories.

Questions of sentiment and the memories of old fights will doubtless delay any settlement on these lines, and possibly we must wait a community of interest which may secure the same result. Local considerations, too, may stand in the way, as it is possible that such a policy, while it would certainly benefit the Bell interests as a whole, might be fatal to some of the smaller Bell companies. The fact remains that we shall not approach perfection in telephone arrangements until every telephone in this country can be connected with every other.

Edison Ore Milling in Europe.

Mr. J. Laurence, president of the Edison Ore Milling Syndicate in England, whom we quoted recently as to the subject, makes the following statement of their hopes and plans:

"The most promising deposit of low-grade iron ore that our expert geologists came across was the vast deposit of iron on the Dunderland River, in Norway, which has been known to metallurgists for a number of years to be the greatest anywhere in Europe. The chief of our scientific staff, Dr. Theodor Lehmann, of Freiberg University, one of the best metallurgists in Europe (who had been conducting similar explorations for some years), made elaborate borings, cross trenches and assays and shipped a large quantity of ore from Dunderland to Mr. Edison for treatment. This deposit had hitherto been commercially unworkable, as being a trifle too lean for shipping direct to the blast furnace, although very rich for the purpose of crushing and concentrating. Another element that had formerly barred its utilization for separating purposes was the existence of a large proportion of specular hematite combined with magnetite. It has only been within the last eight months that our co-director Mr. Edison has been able to solve the problem of separating specular hematite; and as soon as we were satisfied by reports and subsequent personal observations in America that this could be accomplished and at a commercial profit, we at once exercised our option and finally acquired the Norwegian property. We are now enabled to take two tons of this low-grade non-Bessemer ore and, by the combined Edison processes, produce from it over one ton of high-grade Bessemer ore averaging 65 per cent of metallic iron. We have proved already on a portion of the property the existence of over 80,000,000 tons of iron ore, and there is reasonable hope for believing that other parts of this property may turn out proportionately good. It is our intention at present to erect works and ship this ore exclusively to British ironmasters, there being already a market for it at a superior price."

Grottoes at the Pan-American Exposition.

By Orrin E. Dunlap.

The pleasure of the electric launch trip on the canals of the Pan-American Exposition grounds is to be materially intensified by the remarkable experience passengers will have in passing through the subterranean grottoes under the Triumphal Bridge. These grottoes are modeled after the famous Buttes des Chaumont, of Paris. The Triumphal Bridge under which they are located is one of the finest, ornamental structures of the kind. It spans the canals and lakes at the south of the Esplanade, near the southern entrance to the Exposition grounds. It swings from four monumental piers, each 100 ft. in height, each pier being surmounted by a sculptured group. Mr. Rudolph Ulrich is the landscape architect of the Exposition, and in these grottoes he has developed a creation that is thoroughly novel and of unusual size. Beneath the bridge there are two channels, each of which is 400 ft. long, extending in a winding manner through caves and recesses, where the formation is weird in the extreme. Unusual rock forms are all about. Huge branches of coral shape are imitated with surprising truthfulness, and from the roof huge stalactites hang. Rising to meet them at some points are stalagmites, as though about to join in supporting the roof of the strange cavern. Cascades break from the sides.

One of the channels will be wholly illuminated in dark green, and the other with a pink effect. Boats passing to the east will go through the green grotto, while those going westward will make the trip through the pink grotto. The lightng will be done by incandescent lamps deftly concealed. In accomplishing these lighting results Mr. Henry Rustin, chief of the mechanical and electrical bureau, has carried out the conception with a thoroughness that is destined to make the grotto trip famous. Even the ceiling has its incrustation so true to Nature's caverns that one will easily fancy himself far down in the earth in a place resembling the Mammoth Cave of Kentucky.

The Situation in Erie Telephone.

The Erie Telephone situation is becoming interesting, as there are rumors, according to the Boston News Bureau, of a possible contest for control. The Telephone, Telegraph & Cable Company bought in February, 1900, a controlling interest in the stock, 50,001 shares at $115 per share. Later, to secure financial assistance for Erie it parted with 29,000 shares of the stock of the company at $100 per share, retaining 21,000 shares, which now stand at an average cost of $137.38 per share. Soon after the transfer of the 29,000 shares to the Eastern people the stock was raided down to $48 per share for the purpose of compelling the owners of the 21,000 shares and the holders of the 29,000 shares to throw over their stock. Various rumors came to the front, one to the effect that the American Bell Telephone Company proposed to buy Erie at its own price.

After the decline to $48 there was a quick rally to $66, and per-

sons friendly to Bell interests are credited with buying 15,000 shares. Indications now are that the Cable Company is endeavoring to average up its holdings with a view to again securing control, and the new interests at present owning 15,000 shares may try to secure the control in the interests of the Bell Company. If the Bell again loses its control of Erie and it passes into the hands of the independents who, it is said, have already arranged with a large trust company to finance Erie on a broad and liberal basis, all stock purchased under par by the Cable Company will reduce the cost of their present 21,000 shares. The holders of the 29,000 shares are very familiar with the earning power of the company and will be slow to part with their holdings under par and the stock for control must come from the 1800 stockholders.

Gas and Electricity in England.

Mr. Charles Wood, F. C. S., of Bradford, was recently elected president of the Manchester District Institution of Gas Engineers at the meeting held in Manchester, and in his inaugural address to the members dwelt on several questions of special interest to gas engineers. It was often asked, he said, what effect had the supply of electricity on the sales of gas? In the domain of public street lighting they have nothing whatever to fear from electricity, if they availed themselves to the utmost of the possibilities of the incandescent gas burner. In Bradford all the gas lamps had been converted into incandescent; and they were now getting more than twice the amount of light obtained under the old system, and at a slightly less total cost. The alteration had given general satisfaction to the public, and it had been decided not to erect any additional arc lamps at present. Whilst speaking of electrical matters, the possibility of serious injury to gas mains and services from electrolysis suggests itself. In America this has become a grave trouble for gas companies, and he was told by a gentleman, who only returned from New York a fortnight ago, that he had seen in that city alone, miles of gas and water pipes which had been taken up, having been destroyed by electricity escaping from tramway circuits. Electric tramways were now being rapidly extended in almost every town in the country; so that this new danger was a matter for the consideration of every one. There had been in Bradford several miles of electric tramway in operation for two and half years; but so far he had not been able to detect, with certainty, any damage to the pipes from electrolysis, although they had one pipe entirely melted by electricity which had escaped from a faulty cable. This immunity may be accounted for by the fact that nearly all their gas mains were laid under the footpaths; and hence any escaping electricity would have to travel a considerable distance to reach the pipes. This plan should always be adopted in streets where tramways had been or were likely to be placed. One very important feature in connection with the matter, and which unfortunately added considerably to its danger, was the insidious nature of this electrolytic action. The existence of any injury would, in all probability, not be apparent until a whole length of main was completely destroyed.

It is needless to add that Mr. Wood has been grotesquely misinformed as to the effects of electrolytic action in New York. The gentleman just returned from New York has been telling him fairy tales.

Long Distance Telephone Transmission.

Mr. D. M. Therrell, wire chief Southern Bell Telephone & Telegraph Company, writes us from Atlanta, Ga., as follows in regard to work of his about which we have been in correspondence with him for some time:

For the past six years I have been studying the problem of long-distance transmission, and have made numerous experiments along various lines, most of which were without result, though here and there interesting and promising results were obtained, but with perpetual exceptions, generally in regard to articulation, or the transmission of the upper partials or "overtones," so-called.

During the early part of the present year I have, however, been enabled to obviate this difficulty, and have succeeded in scoring some rather remarkable results. I now claim to be able to transmit the upper partials as far as the prime or fundamental. With my apparatus I have successfully talked over circuits 2300 miles long, including 13 miles of cable. As you are aware, the present long-distance limit falls closely around 1300 miles, or, as we put it, 1350 miles. I also talked successfully with the same equipment over 646 miles of No. 12 copper wire with 15 local stations and 6 exchanges in circuit, a result, if anything, more remarkable than the former.

Important Telephone Consolidation in Pittsburg.

The absorption by the United Telephone & Telegraph Company of the Maryland Telephone & Telegraph Company, the Pittsburg & Allegheny Telephone Company, and certain other telephone properties, is announced. The consolidation includes the following-named properties:

"Maryland Telephone & Telegraph Company, capital, $1,000,000; Pittsburg & Allegheny Telephone Company, capital, $1,500,000; West Pennsylvania Long-Distance Telephone Company, capital, $1,000,000; Home Telephone & Electrical Company, capital, $200,000; Allegheny County Telephone Company, capital, $200,000; Harford County Telephone Company, capital, $10,000. In all about 50,000 telephones will go into the combination. The United Company obtains a strong position in Pittsburg territory by the interests absorbed there. This territory is regarded from a Bell viewpoint as the third best in the United States for local service and second only to New York for long distance business. The West Pennsylvania Long-Distance Telephone Company owns the line from Pittsburg to Beaver, Pa., where connection is made with the United States Long-Distance Company, that will give service into Cleveland and other Ohio and Indiana points. Over 167,000 telephones will be connected by this line with the Pittsburg and Allegheny plant. The West Pennsylvania Company is building toward Harrisburg, where it is to meet the proposed long-distance line from Baltimore." Apparently the local Pittsburg reporter was long on ciphers when this item was dictated, for the recorded capitalization of the West Penn Telephone Company is only $10,000, and that of the Home Telephone Company $100,000. Then there is no telephone line from Pittsburg to Beaver, except the Bell circuit, and no connection is made at Beaver with the United States Telephone Company, as the latter company has neither built across Beaver County nor even to the Ohio line. And if the West Penn Company is building east from Pittsburg towards Harrisburg, it must be news to the telephone fraternity in Pittsburg, unless reference is made to the long lines the Federal Company is building in Westmoreland County.

Three months is a very short time to accomplish much building. Hence it is generally surmised that the Federal Company is on the inside in some present negotiations. The press dispatch further states: "It is expected within the next three months to have about 27 towns around Pittsburg connected with the Pittsburg & Allegheny Telephone Company, which will give the United Telephone & Telegraph Company about 20,000 telephones in that section." Outside of the Federal Company's plants, there are not a thousand independent telephones in all of Allegheny County outside of the cities of Pittsburg and Allegheny.

No lines have been completed, and the indications are that before the work is a success some other plans will have to be adopted than those of trespassing on the right-of-way of other companies, or of attaching wires to the poles of other companies without permission.

On April 5 the statement appeared in the *Dispatch* that "the Pittsburg & Allegheny Telephone Company owns a franchise in Washington, D. C., and plans are now formulating for a connection from that point to this city. A line to Cleveland is about completed." The press dispatch more accurately stated that the company "had been at work to secure a franchise from Congress for the City of Washington. This is expected to be granted at the next session." The facts are that in its closing hours the United States Senate sat down on the measure, voting adversely to granting such a franchise. Commenting on this announcement, the local Pittsburg *Dispatch* editorially states that "all of the companies named were organized by practically the same people and for convenience of operation and efficiency of service are now brought under one management. As may be seen from the data relating to territory covered and number of instruments installed the United is a quite formidable system. The public is friendly to it because it has brought the benefits of competition into the telephone field, but wisdom dictates that future franchises granted to it shall contain the same limitations of charges and prohibition of transfers of property that were incorporated in the original grants, merely as a guarantee that competition shall continue."

The Conversazione of the American Institute of Electrical Engineers.

JUDGED by any and all of the standards of success, the Conversazione of the American Institute of Electrical Engineers at Columbia University, on April 12, must be rated very high. The exhibits were on a high plane of unusual excellence, the arrangements, made with great care, all worked out smoothly, and a beautiful night after a week of bad weather enabled 1200 people to attain with comfort the crest of Moringside Heights from which the great new buildings of the University look down over the whole Island of Manhattan. To the flattering success achieved, several causes contributed, of which note will be made, but the original incentive came from abroad. While the Institute was in Europe last year, its officers and members participated in several functions, one of the most notable of which was a reception given in Paris by Prince Roland Bonaparte, at which the combination of hospitality with features of scientific interest was so great that it was at once determined by Messrs. Hering, Mailloux and others to try the same thing on the return home. During the winter the matter was referred by the Council to the Committee on Papers and Meetings, and an appropriation was made from general funds in the belief that the resultant good to the society would be considerable. The chief difficulty was to secure a building adequate to the purpose, but this was met through the activity of Professor Crocker, past president, who secured from President Low permission for the use of the Engineering Building. This privilege was in itself an enormous boon, for it not only furnished the best surroundings, but gave many members for the first time an opportunity to see the University itself. As the work of preparation advanced, it was found that the building named would not be sufficient to accommodate all the exhibits and guests, and Havemeyer Building was added, as well as the Engineering and Mechanical Laboratories, thus providing for a separation of the exhibits and free circulation for the hundreds of visitors. The next elements of success may be found in the untiring energy of the committee of arrangements, and the readiness with which members came forward with offers of interesting exhibits. As will be seen from the subjoined report in detail, over 30 distinct exhibits were selected, each of which possessed features of importance beyond the ordinary, and many of which were of the greatest novelty and attractiveness. And it may properly be noted that the desire to cooperate was not confined to the rank and file, but was manifested in equal degree by the leaders in the profession, Mr. Edison returning from his Southern holiday in time to be present, and such men as Professor Elihu Thomson and Mr. Nikola Tesla furnishing personal exhibits of the greatest interest. In fact, of the reception committee consisting of 32 members, 24 were in attendance, as follows, and of those absent none are residents of New York: President Hering W. S. Barstow, Elihu Thomson, F. J. Sprague, W. A. Anthony, J. W. Lieb, Jr., C. F. Scott, L. B. Stillwell, Herbert Lloyd, T. C. Martin, F. B. Crocker, G. F. Sever, S. Sheldon, W. J. Hammer, E. Caldwell, R. W. Pope, G. S. Dunn, C. P. Steinmetz, W. D. Weaver, C. W. Rice, R. D. Mershon, R. T. E. Lozier, C. O. Mailloux, M. I. Pupin.

No fewer than a dozen rooms were occupied for the purposes of the Conversazione, with the laboratories, cloak rooms, etc., in addition. Entrance was effected through Havemeyer Hall, over whose door an electric sign, "A. I. E. E.," was hung, and over a hundred feet of awning, illuminated with incandescent lamps, connected the hall with the Engineering Building. The large lecture room in Havemeyer was devoted to Mr. Tesla's experiments, for which several tons of apparatus had to be installed in less than 12 hours after regular lectures in the morning, while a special high-voltage circuit was run up to the college by the New York Gas & Electric Light, Heat & Power Company. All the other exhibits were practically concentrated in the Engineering Building, except that of telpherage, which requiring a long stretch, was run the length of the mechanical laboratory, where the big locomotive was also in operation with a crew of students. On the ground floor, Professor Thomson and Mr. Peter Cooper Hewitt each had a large room to themselves, and the other exhibits were grouped by subject or the exigencies of space. A band of music was located on one of the upper floors, and in another large lecture room there Mazzetti served an admirable collation to over 1000 people, without any trouble or confusion whatever. Each exhibitor was allowed three assistants, while Professors Crocker, Sever and Townsend organized a corps of some 50 students as ushers and aides, the young men being most obliging and useful. Much care was given to details. A special insurance of $15,000 was taken out on the exhibits, policemen and firemen were in attendance by request, and the Metropolitan Street Railway Company had a special provision of cars to bring people up from downtown, or to connect with convenient stations on the elevated road. All admission to the Conversazione was by ticket, each member receiving two if applied for, and being allowed to subscribe by name for friends up to a certain number. For all this endless work the committee of arrangements, comprising Messrs. W. S. Barstow, chairman; Caldwell, Hammer, Crocker, Martin, Rice, Lozier and Sever divided up, and it must be heartily congratulated on the results obtained. One of the most praiseworthy things it did was to provide a handsome 16-page pamphlet, in which all the exhibits were described in detail, with their location, this being supplemented by brochures furnished by the United States Government, from the Smithsonian Institution, in regard to the exhibits relating to Professor Langley's bolometer and aerodrome.

The attendance was quite remarkable not only as to its size, but in the matter of quality, and included judges of the various courts, officers of the army and navy, the clergy, professors and many well-known members of New York society. Among the officials of Columbia were President Low, Dean Woodward and Professors Hutton, Laudy and Hallock, the first named being accompanied by the German Ambassador, Baron von Holleben, with Herr P. Glasenapp, the engineer attaché of the Imperial Embassy. There were also present several of the foreign consuls in New York, and last, but by no means least, a party of students in physics from Vassar College, in charge of Misses Stone and Cooley, professors in that department. The visitors were all in constant circulation in the museums and laboratories, in the Röntgen ray rooms, in the Elihu Thomson and Cooper Hewitt exhibits, studying Mr. Hammer's wonderful series of balloon pictures, crowding into Mr. Tesla's demonstration, trying to understand Dr. Pupin's apparatus for long distance telephony, listening to the akouphone, delighting at the sparkle of Mr. Andrews' aluminum cell, learning about alternating-current waves from Professors Ryan, Townsend and others, and marveling at the "miles of talk" reeled off in the Poulsen telephonograph. It was midnight before all the resources of the entertainment had been exhausted and the first Conversazione of the Institute had passed into history.

The press notices in regard to the affair have been most generous and extensive, and their general tenor is best represented by the following extract from a leading editorial article in the New York *Tribune:* "The American Institute of Electrical Engineers is to be congratulated upon the attractiveness of its Conversazione on Friday evening. In Europe the combination of an exhibition showing recent advances in science with an evening reception is a familiar occurrence; but in America it is something of an innovation. Moreover, an undertaking of this sort involves a large investment of time, trouble and tact on the part of both the exhibitors and the committee of arrangements. But such a venture yields a handsome return in educational results. And those who contributed, by material or service to this particular one have reason for just pride over its success."

OSCILLATOR EXPERIMENTS.

The fact that Mr. Nikola Tesla is most busily occupied with his preparatory work for signaling by wireless telegraphy across the Atlantic was in itself sufficient reason why that distinguished inventor should not be able to participate in the proceedings at the Conversazione, but yielding to the urgent request of the committee of arrangements, Mr. Tesla, to whom the Institute is already indebted for more than one brilliant demonstration, went to considerable pains and trouble to contribute to the exercises of the even-

ing. With the assistance of Mr. Lozier, he transported several tons of apparatus from his laboratory downtown up to the big lecture room in Havemeyer Hall the afternoon of Friday, as the room could not be occupied before that time. Within the brief space of 6 or 8 hours the whole of the apparatus, including the converters, oscillators and temporary circuits connecting with the outside lines brought to the building by Mr. Calvin Rice through the courtesy of the New York Gas & Electric Light, Heat & Power Company, was set up, tested and put in operation. The hall, which ordinarily accommodates about 350 people sitting, will perhaps provide for 400 to 500 when crowded, and it had been arranged to give not less than two demonstrations. The first went off most successfully, and the extraordinarily brilliant effects obtained by Mr. Tesla with vacuum tubes, special coils of wire and free ends of wire in air, were given to the intense delight and satisfaction of the largest audience the room would accommodate. So profuse were the discharges in free air from the apparatus, the audience had to retire somewhat precipitately from the front three or four benches, leaving Mr. Tesla a clear space of 8 or 10 ft. around the apparatus, and even then in the darkness the discharges were of a most weird and awe-inspiring character. It was found at the close of the first performance that the converter supplied temporarily for Mr. Tesla's use instead of the one used by him in his laboratory had become so overheated as to be incapable of further service, and as no other was obtainable at that late hour of the night, it was found impossible to give a repetition of the display, to the intense chagrin of hundreds of people who were waiting. Mr. Tesla, however, apologized for this disappointment in a very charming manner, and volunteered his readiness to give a further demonstration before the members of the Institute at such time as might be found suitable and convenient. The display, while not particularly novel to those who have seen Mr. Tesla's previous work, was certainly one of the great features of the Conversazione, and Mr. Tesla is entitled to warm thanks of the Institute for the inconvenience to which he put himself in order to take part in the affair.

ANALYSIS OF HIGH-FREQUENCY SPARK.

An interesting apparatus was shown by Mr. W. S. Andrews, which had been devised to study the high-frequency spark. The appartus was very simple, consisting merely of a glass tube of small bore mounted as a radius on a revolvable disk. As installed, the apparatus was connected with an alternating-current circuit of 118 volts and 58 cycles. The current was conducted into the tube, which had a bore of only .25 mm, by wires inserted in the ends, there being an air-gap about 5 inches long inside the tube. The tube was revolved while illumined by the discharge, the optical effect being a circle of bright radial lines. Under these conditions, the number of primary radii is obviously determined by the ratio between the alternations and the speed of rotation, but the characteristics of the primary radii may be changed by manipulation of the apparatus.

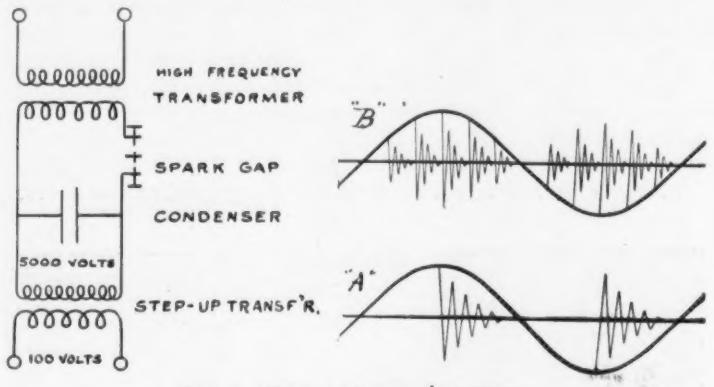
Referring to the diagram of high-frequency apparatus shown in Fig. 1, when the spark-gap is set at a certain length and the potential of the transformers adjusted so that the condenser discharge will only just arc across it, the radii will appear as single lines, indicating that the condenser discharges only once during a half wave (see "A," Fig. 2).

If the primary potential is now increased, or if the spark-gap is shortened, the single radii will be seen to open out like a fan into two or more lines, thus indicating a corresponding number of condenser discharges during each half wave (see "B," Fig. 2).

To obtain permanent records of the different effects, photographs were taken from which the prints of Figs. 3, 4 and 5 have been made. Figs. 3 and 4 show snap exposure of the high-frequency sparks during two and three half-waves, respectively.

Fig. 5 shows a star produced when the tube was revolved at 430 r. p. m. During each half revolution eight compound radii were formed in each half of the circle, corresponding to eight half waves in a 58 cycle current.

It would be difficult, if not impossible, to record any purely high-frequency oscillations by the present method, as a sufficiently high speed of rotation could not be attained. The results here described, however, appear to present a clear proof that each half-wave may be the source of a number of groups of high-frequency oscillations. It therefore follows that an arc across a high-potential circuit containing inductance and capacity ruptures itself instantly, so that, if the voltage is high enough it can occur repeatedly during each half-wave.



FIGS. 1 AND 2.—ANDREWS' EXHIBIT.

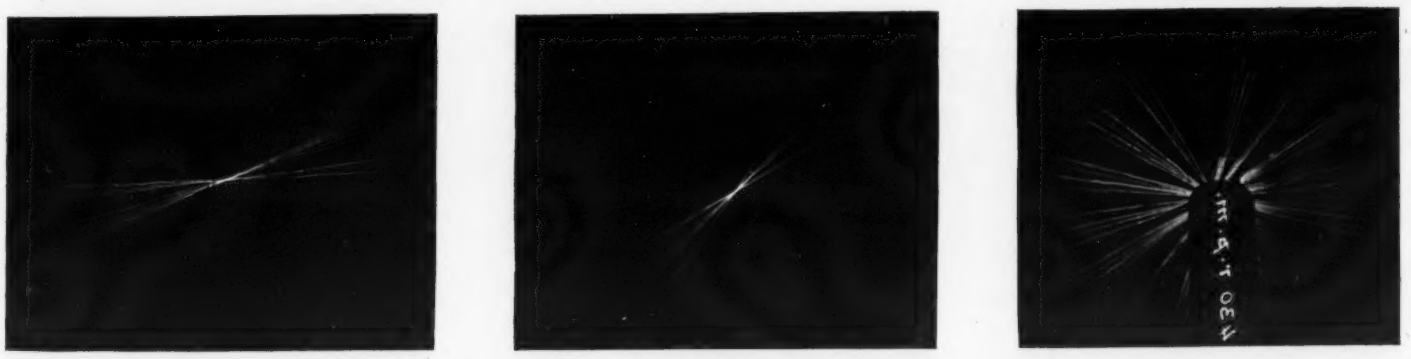
LUMINOUS ALUMINUM CELL.

Another exhibit by Mr. Andrews consisted of a luminous aluminum cell. This cell is composed of a plate of aluminum and a plate of carbon suspended in a saturated solution of Rochelle salts (double tartrate of potash and soda).

The peculiar property of the aluminum cell in retarding a flow of current in one direction is well known. There is practically no resistance to the passage of current through the electrolyte from the carbon to the aluminum, but a high resistance is encountered in the opposite direction. Many attempts have been made to use these cells for rectifying alternating current, and changing it into a pulsating unidirectional current, but their low efficiency is a serious bar to any commercial application.

When two of these cells are connected in opposition to each other across an alternating current, the e. m. f. of which can be controlled from zero to about 200 volts, a very interesting phenomenon may be observed, the experiment being performed in a darkened room. With two newly charged cells the current should be connected at about 5 or 10 volts, and the voltage gradually increased, to prevent a sudden rush of current. At 40 or 50 volts the aluminum plates will be seen to glow with a faint phosphorescence, which will grow brighter as the voltage is raised. Little stars will then appear on the luminous surface, and these will increase in number and brightness until finally the aluminum plates will become glowing fields of beautiful scintillations, each point of light continually changing in position and brilliancy.

The phosphorescence and scintillations on the surface of the plates will extend for a short distance above the level of the liquid, and



FIGS. 3, 4 AND 5.—ANALYSIS OF HIGH-FREQUENCY SPARK.

a pretty effect may be produced by slightly tipping the cells so as to momentarily wet a larger surface of the plates.

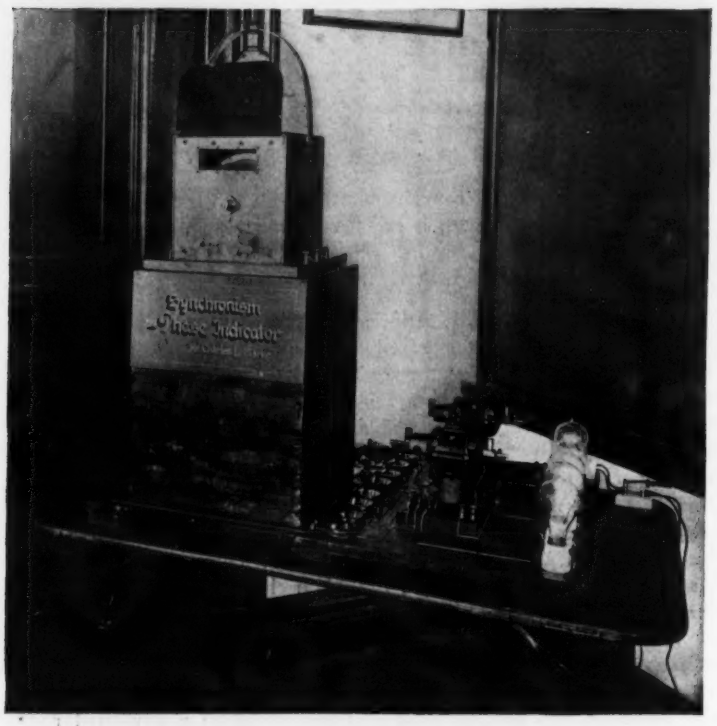
The voltage necessary to produce these results will vary with the size and condition of the plates and the density of the solution. It will, however, be always safe to begin at a low voltage and gradually work upwards.

The high resistance of these cells to the passage of current in one direction is probably due to the formation of a film of non-conducting oxide on the aluminum, through which a great number of minute disruptive discharges may produce the appearance of scintillations and phosphorescence.

SYNCHRONISM AND PHASE INDICATOR.

An apparatus which attracted the particular attention of technical visitors was exhibited by Mr. Charles L. Clarke, and is illustrated below. This consists of an instrument for indicating when the frequency and phase relation of alternating-current generators are such as properly to permit them to be connected in parallel. The instrument is shown on the left of the illustration, the apparatus on the right having been installed to demonstrate its practical operation.

In the case are two 12-pole single-phase synchronous motors,



SYNCHRONISM AND PHASE INDICATOR.

which respectively rotate two blackened aluminum disks in opposite directions. The motor shafts are axially in line, so that the disks carried by them are one directly behind the other, and located as close together as practicable. Six narrow slots, extending radially inward, are cut in the circumference of each disk at equal distances apart. A brilliantly lighted white screen is located behind the disks. The stroboscopic effect of viewing the screen through the slots in the disks as they rotate appears in the form of an image, consisting of a series of bright, narrow radial lines arranged circumferentially upon a black background. The number and distance apart of the lines and whether or not they move, or are stationary, depends upon the relative speed of the disks.

At the circumference of, and in the same plane as, the front disk is located a scale, which reads to 180 degs. on each side of a zero line, and embraces one-twelfth of the circumference of the disk. Directly behind this scale, and in the plane of the rear disk, is located another similar scale. The two scales together constitute a single scale for avoiding error due to parallax. The scales are fixed together, and, as a whole, are capable of a certain amount of motion about the disks for adjustment.

When the disks rotate at or near the same speed and, therefore, the motors are at or near synchronism, the characteristic image appears, in which case 12 lines at equal distances apart (360 degs. apart as measured on the scale) are seen. These lines will be stationary if the motors are in synchronism, or slowly rotate if the motors are nearly in synchronism, the direction of motion depending upon which motor is going the faster.

To adjust the scale both motors are connected with the same source of e. m. f., with the necessary result that they run in synchronism, and, therefore, the characteristic image appears, and its lines are stationary and assume the position for zero difference of phase. The scale is then adjusted to bring its zero line opposite a line of the image.

No further explanation is necessary to make it apparent that with the two motors respectively operated by two generators, the appearance of the characteristic image will indicate, if its lines are stationary, that then the generators are in synchronism; or, if the lines are rotating in either direction, which generator has the greater rotary speed. The position of a line on one or the other side of the zero line of the scale (only one line of the characteristic image can be inside the limits of the scale at the same time) will indicate the lead or lag, respectively, of the e. m. f. of one generator relative to that of the other.

The construction above described relates to an indicator operated by 12-pole motors. In general, with motors having n poles the disks should each have $\frac{1}{2}\ n$ slots, and the scale embrace the nth part of the circumference of the disks. The characteristic image will have n lines.

The indicator exhibited had single-phase motors, as before stated, and naturally had to be started in operation by mechanical means, which was easily and simply accomplished by twirling knobs on the armature shafts. By use of split phase, or polyphase motors the indicator is self starting. But the construction is much simplified by using single-phase motors, and the apparatus is in every way just as accurate and applicable to practical use.

Besides its use for the connecting-in of generators, as before described, this indicator is also applicable for showing the phase relations of a current and an e. m. f., or two currents of the same frequency.

BOLOMETER.

Professor S. P. Langley, director of the Smithsonian Institute, showed a bolometer of the form which he devised for conducting his researches on heat, and since has employed in studies on the solar and lunar spectra. The salient feature of the apparatus consists in a wire, or rather a "tape" of platinum, of a length of 10 mm or less, a width of a tenth of a millimeter or less, and a thickness of less than one one-hundredth of a millimeter. This is made one of the arms of a Wheatstone bridge, the other arm being shielded from the radiation of the object under examination. The action rests on the principle that the heating of an ordinary metallic conductor increases its resistance. The application of it here carries us into what may be almost called the "physical infinitesimal" in which the principle is still found to hold good for an almost infinitely small change of resistance. Through the two arms of the bridge flow currents from a battery. This battery current, which may be roughly taken at a tenth of an ampere, is equally divided between the bridge arms, until the heat (by causing a change of temperature which may be less than one one-thousand millionth of a degree in the exposed arm) induces an increase of resistance and a consequent flow through the galvanometer, represented by a current which need not be more than 0.000,000,000,001 of an ampere, a deflection of 1 mm on the scale of a special reflecting galvanometer (not here described) corresponding to a change of temperature on the bridge of nearly 0.000,000,001 of a degree centigrade.

The bolometer would evidently be comparatively useless if any accidental heat radiations reached it which were not connected with the object under immediate examination. Accordingly, it is kept free from external temperature variations by a case surrounded by a water-jacket and by other aids. It is used in a chamber of constant temperature, where the heat is automatically controlled so as to be the same in summer and winter and in day and night.

Accompanying the bolomoter case were shown several types of bolometers made for special purposes, in all of which, however, strips or "tapes" of platinum are employed as one of the minute arms of the enclosed "bridge." A drawing was exhibited showing in detail the construction of the bolometer and the balancing coils combined within one water jacket, and also a diagram showing the electrical connections of the apparatus and illustrating the principles of its action.

ELECTRIC LIGHT FROM VAPOR TUBES.

Without doubt the exhibit which attracted the most attention was that of Mr. Peter Cooper Hewitt, consisting of mercury vapor tubes for the production of light upon the passage of a current through the tube. Various forms of these tubes are shown in the cuts below. The simplest form consists of a plain cylinder having a bulb at one end containing mercury. Before sealing, the tube is partly exhausted. The amount of exhaustion was not stated, but it was said that no tube was exhausted below a pressure corresponding to 1 mm. of mercury when running.

In Figs. 3, 4 and 5 are represented different sizes of tubes, each accompanied by data, a comparison with which gives the relation of voltage to the length and diameter of the tube. Fig. 2 shows a lamp in which the tube is coiled. In starting up a higher voltage than normal was used to start the discharge through the tube, but it was stated that tubes could be put in operation without having recourse to a high starting voltage.

A number of sheets of curves were exhibited, showing the variations of efficiency under different conditions and with currents of different value. Engravings of these curves will be printed in an early issue. One of the curves referred to a tube 54½ inches long with an inside diameter of one inch, which at 74 volts and 3 amperes gave a candle-power of 700. As a calculation will show, this corresponds to .32 watt per candle. The photometric value was determined by measurement at right angles to the axis of the tube, and, therefore, does not correspond to the basis upon which candle-power of incandescent and arc lamps is determined. The illumination afforded by a single tube was, however, very large, lighting brilliantly a room which normally is lighted by two enclosed arc lamps.

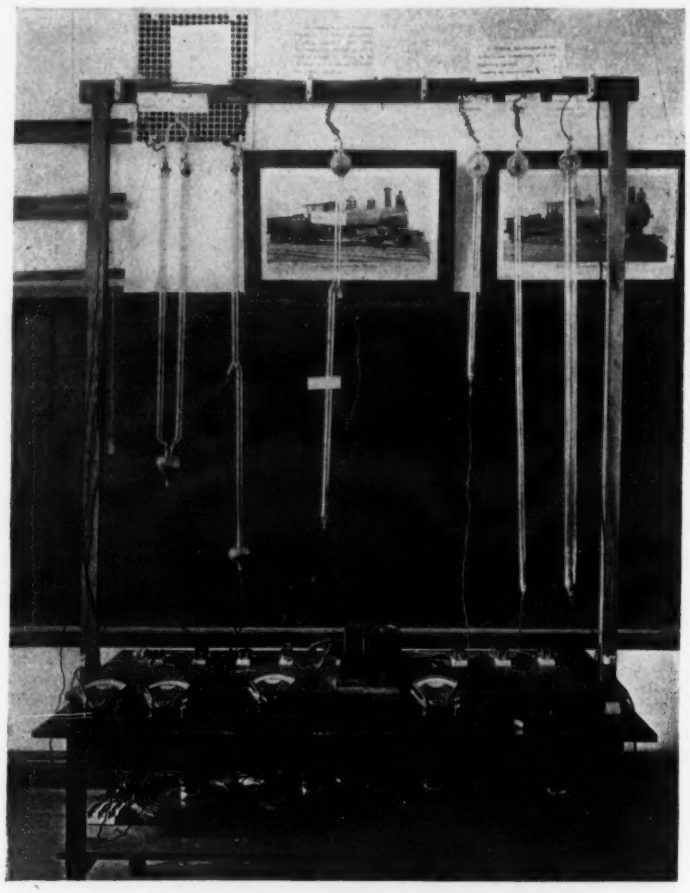


FIG. 1.—GENERAL VIEW OF VAPOR TUBE EXHIBIT.

INCANDESCENT LAMP EXPERIMENTS. PHASE INDICATOR.

Professor W. E. Geyer showed an interesting arrangement to illustrate the properties of parallel alternating-current circuits containing inductance and capacity. One of the parallel circuits contained inductance in series with a lamp and the other parallel circuit a capacity, also in series with a lamp. In one of the legs connecting the parallel circuits to the source of e. m. f. was a third incandescent lamp. When current was turned on the third lamp glowed dimly, while the two lamps in parallel each glowed at full candle-power. The apparent paradox of a lamp burning dimly through which presumably the current for both of the brightly glowing lamps passed, was explained as being due to a storage of energy in the inductance and condenser of the parallel circuit, which caused a surging current in that circuit that did not appear in the circuit including the dimly glowing lamp. Dr. Geyer also showed a method for indicating phase difference. In series with an alternating-current arc lamp is a synchronous motor driving a stroboscopic disk, the disk having a black surface with the exception of a sector of 10 or 15 degs., which is white. When the current is turned on, the position in space of this sector appears to be fixed since the eye is preponderatingly affected by the disk when the reflection of light is maximum, which maximum occurs when the current passing through the lamp, and consequently through the alternating-current motor driving the disk, is at a maximum. If the apparent position of the sector is vertical when it is on one leg of a two-phase circuit, it will be horizontal or 90 degs. distant when the arrangement is switched onto the other leg of the two-phase circuit.

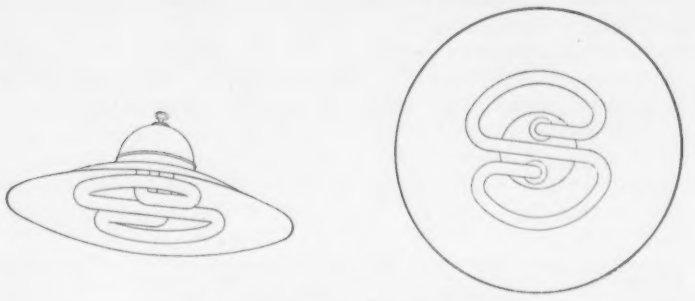
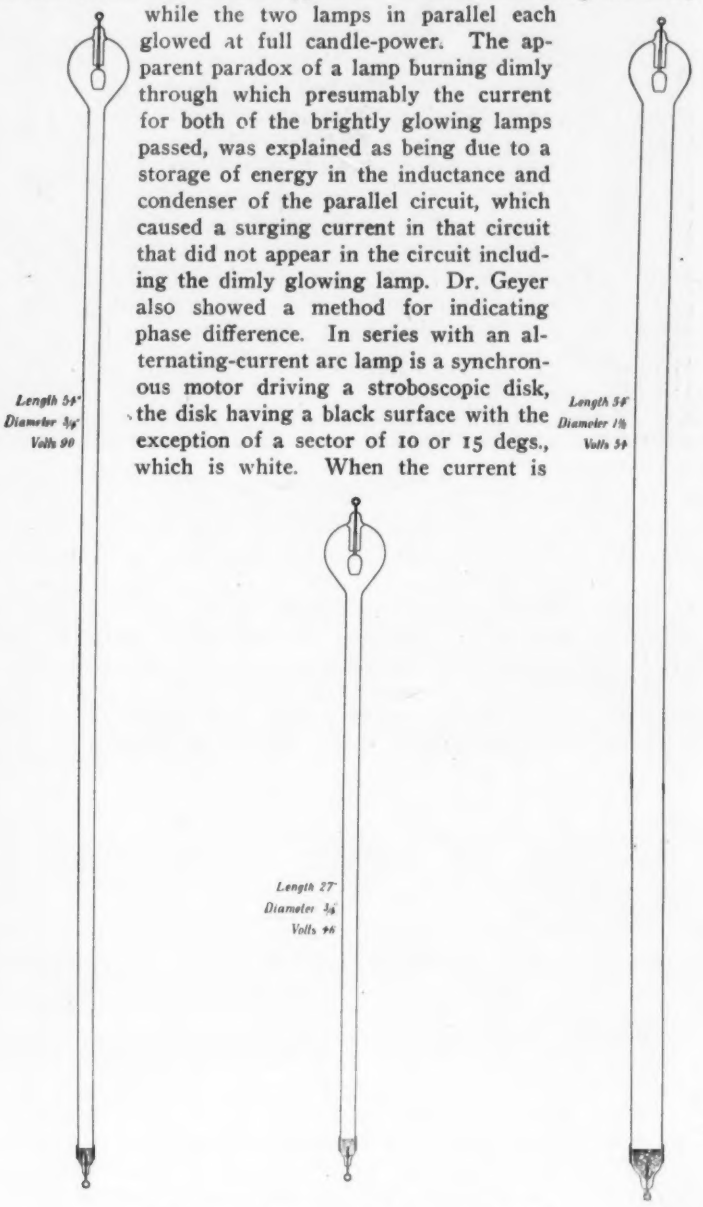


FIG. 2.—LAMP WITH COILED TUBE.



FIGS. 3, 4 AND 5.—TUBES OF DIFFERENT SIZES.

EXHIBITS OF PROFESSOR ELIHU THOMSON.

One of the main attractions of visitors, both technical and lay, was the exhibits of Professor Elihu Thomson, which consisted of three items, two of which are shown in the cut below. One exhibit was an aluminum disk mounted on a vertical shaft free to rotate, and embraced by the two legs of an alternating-current electromagnet. The electromagnet is adjustable so that a greater or less portion of the disk can be embraced, and also to enable the magnet to be shifted in position so that the plane of its legs may make a different angle with a tangent to the disk. When current was turned on the electromagnet, the disk would remain stationary or move in one direction or the other, according to the position of the electromagnet with

EXHIBITS OF PROFESSOR ELIHU THOMSON.

relation to the disk. Another exhibit was a rotary electrical apparatus (see above) consisting of an iron sphere heavily electroplated with copper and suspended on gimbles so that it may revolve in any axis or in any plane, there being two gimble rings. Surrounding this sphere are three coils at right angles to each other. By suitably energizing these coils with polyphase currents, the sphere was made to revolve on any axis or in any direction, so that it may be said the apparatus illustrates a three-dimension polyphase system and also the principles of the gyroscope and the Bohenberger sphere. The switching arrangement was such that current could be passed through any one or two or all of the coils, and in direct or reverse order.

The third exhibit was a dynamo-static machine which was an improved form of one shown about two years ago at a meeting of the New York Electrical Society. This machine contains a small direct-current motor, the windings of which are tapped and connected to two rings, giving a primary alternating current for the operation of a step-up transformer, which gives a secondary current that can be regulated through a range up to about 20,000 volts. The tops of alternating-current waves of high potential obtained from this secondary transformer are used to charge a number of glass plate condensers in parallel. The rotating frame synchronously driven with the motor makes connection to the condensers periodically and in synchronism with the alternating current. The connection by the rotating frame is alternately in parallel and in series; the condenser plates may thus be charged to 15,000 volts with 10 plates in parallel, giving 150,000 volts when connected in series. The machine thus furnished from low tension direct-current high-potential discharges of definite polarity at the machine terminals.

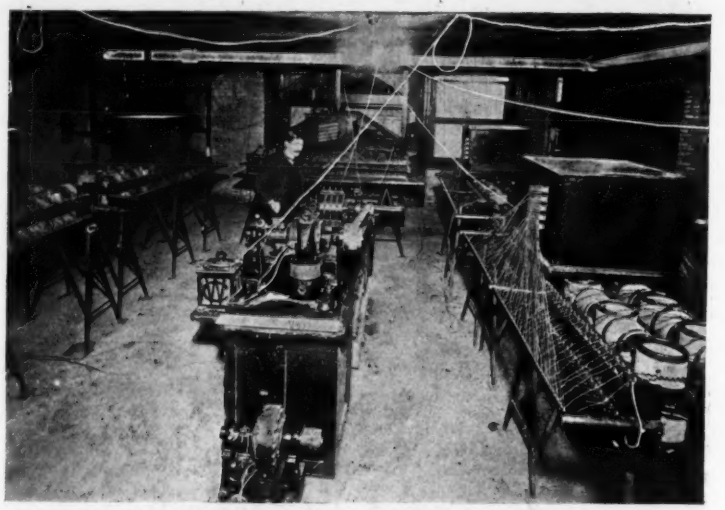
TELEPHONOGRAPH AND AERONAUTICAL PICTURES.

Mr. W. J. Hammer showed a collection of photographs, mostly taken by himself, of aeronautical subjects, comprising photographs of Professor S. P. Langley's aerodrome, Sir Hiram S. Maxim's flying machine, Santos-Dumont's dirigible air-ship and Count Zeppelin's balloon. Also photographs made from balloons during the Aeronautical Congress at the Paris Exposition of 1900, and by the Aero Club, of France.

Mr. Hammer also exhibited a Poulsen telephonograph. An illustrated description of this interesting apparatus appeared in our issue of April 21, 1900. Briefly, the apparatus consists of a brass drum, 11 × 5 inches, upon which is wound piano wire. Resting upon the wire is a tiny electromagnet, which is connected to a carbon telephone transmitter, a couple of cells of battery, and an induction coil in the usual manner. When the transmitter is spoken into the magnet transversely magnetizes the steel wire as the drum revolves, and the magnetic lines of force are permanently recorded therein. After the steel spiral is filled—which operation takes about 39 seconds, and permits the recording of 100 to 120 words—the tiny magnet is placed in its original position, and connected with a Bell receiving telephone; the cylinder is again revolved, and as the magnetized steel wire passes before the poles of the electromagnet, it forms a species of magnetoelectric generator, giving out currents of electricity of a strength and direction corresponding to the magnetization of the steel wire, which correspondingly affect a Bell telephone held to the ear, and reproduce the sounds and words originally spoken, with absolute fidelity. In addition, there was shown the band form of telephonograph and a dictation machine for office use.

PUPIN LONG-DISTANCE TELEPHONY EXHIBIT.

The cut below shows the exhibit of Dr. Pupin, consisting of an artificial telephone line which was constructed to test the mathematical deductions of Dr. Pupin relating to the reduction of the distortion and attenuation of telephone currents on long land overhead lines and in cables. The apparatus consists of such a distribution of capacity and resistance as corresponds with an actual line, and the connections are such that inductances may be plugged in at various intervals. During the Conversazione demonstrations were given, showing that if inductances are inserted in a certain definite relation with respect to the length of the line, telephonic communication is carried on with as much ease as if the line were but a few rods long, whereas the artificial circuit corresponded to a line some hundreds of



DR. PUPIN'S LONG-DISTANCE TELEPHONY EXHIBIT.

miles in length; on the other hand, it was shown that if the same amount of inductance were plugged in without regard to the law discovered by Dr. Pupin, conversation was rendered impossible, and the same was true when the line contained no artificial inductance.

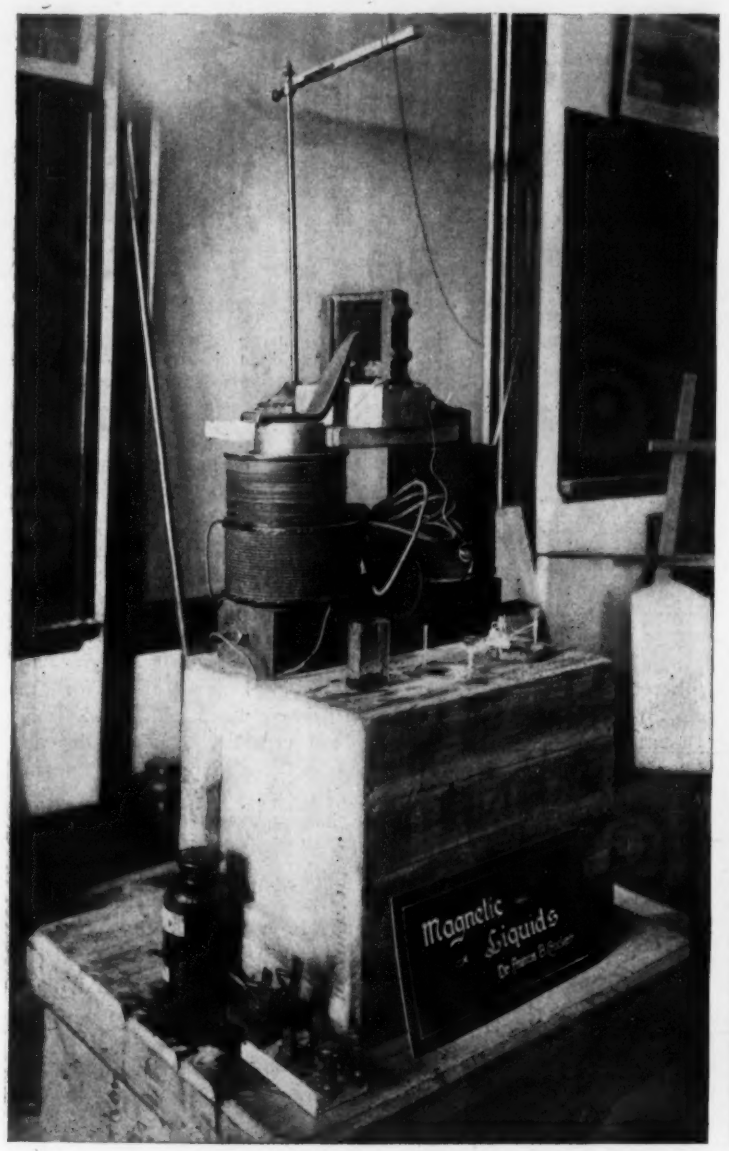
TELPHERAGE SYSTEM.

A very interesting exhibit of the new system of telpherage was made in the Mechanical Laboratory by the United Telpherage Company, which was represented by Mr. J. B. Wallace, C. W. McMullen, C. L. Riley, A. F. Clift and T. B. Peck, Jr. There was naturally considerable difficulty in securing long enough stretch of space to display this system to advantage, but it was found by running a cable for about 100 ft. above the tanks and steam pipes, etc., in the laboratory and securing the two ends by stout temporary supports, a demonstration could be made. The contact wire for the sleeve trolley was slung above and thus the telpher was able to travel up and down at a good rate of speed and display to advantage the handiness of this ingenious system for handling freight, mail, etc.

It was evident that to a great many of the visitors, including, be it said, not a few engineers, the idea of sending actual material along a wire electrically was wholly new, and the skill and ease with which the operation was effected elicited a great many warm commendations. Those who put up the temporary exhibit under the exacting conditions are to be congratulated upon the success achieved by their demonstration, which in itself illustrated admirably the manner in which such a method of transportation can be adapted to buildings whose floor space is congested with all kinds of apparatus, and where, therefore, the transportation of material is correspondingly troublesome.

ILLUSTRATION OF PARAMAGNETISM AND DIAMAGNETISM OF LIQUIDS.

The cut below shows an arrangement exhibited by Professor F. B. Crocker for illustrating the magnetic properties of liquids and for measuring their permeability. The liquids are contained in small phials immersed in another liquid and situated within a powerful



PROFESSOR CROCKER'S MAGNETIC LIQUID EXHIBIT.

magnetic field. As exhibited, one of the phials contained a paramagnetic liquid consisting of a salt of iron, and the other contained a diamagnetic liquid. When the field was established the former tended to move toward the strongest part of the field, while the latter tended to move toward the weakest part of the field.

U. S. SIGNAL CORPS EXHIBIT.

One of the most extensive exhibits was that of the U. S. Signal Corps, which was collected and installed under the supervision of Colonel Samuel Reber, U. S. A. The wireless telegraphy apparatus was of particular interest, as it embodies a number of improvements suggested by experiments on a practical scale; in fact, the Signal Corps has perfected a complete system of its own, which is the first practically operated in this country, and by means of which regular communication has for some time been established between stations in the harbors of New York and San Francisco.

The receiving apparatus is shown in Fig. 1, and consists of a specially constructed relay; the coherer and decoherer, the former containing nickel and silver filings and being adjustable; a telegraph printer, and two two-point switches, one for testing the decoherer and the other for testing the printer. All of these instruments are mounted on a base which contains the various connecting wires, coils, etc. The whole device is covered by a neatly polished box, and when ready for shipment measures $38 \times 18 \times 14$ inches.

The sending apparatus consists simply of a large induction coil and an ordinary telegraph key, a four-cell storage battery furnishing the current; 7.5 amperes at 10 volts is used in the primary, and with a spark 1½ inches in length, about 12 words can be transmitted per minute. By means of two split plugs and receptacles for the same on the base of the receiving apparatus and the two ends of the secondary of the sending coil, the operator can quickly change

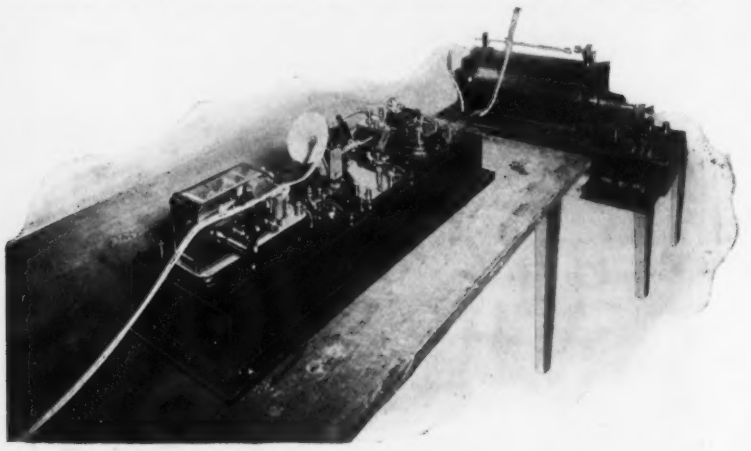


FIG. 1.—WIRELESS TELEGRAPH RECEIVING APPARATUS.

over from receiving to sending, and vice versa.

Another series of apparatus shown, which has been developed to a point of great efficiency, are the field telegraph and telephone kits and portable switchboards. Three of these are shown in Fig. 2. The device on the extreme left is known as "Type C" kit, and

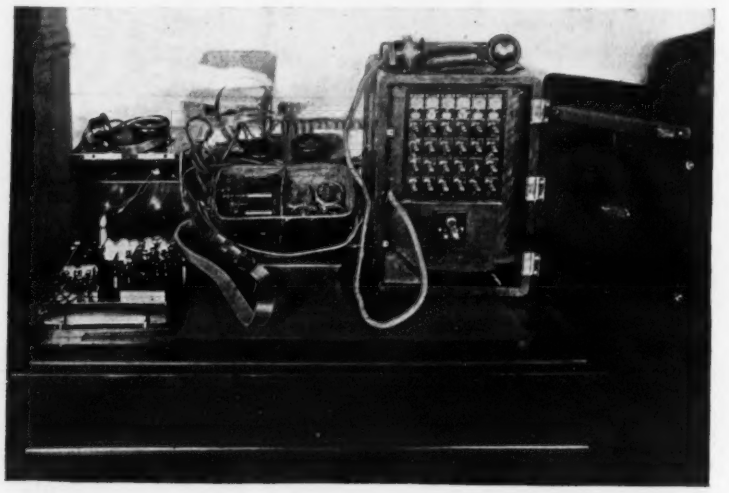


FIG. 2.—FIELD OUTFIT.

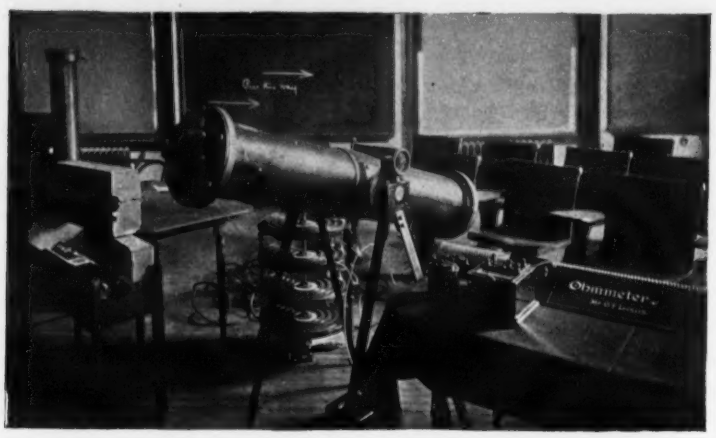
is a combination telegraph, telephone and phonoplex. By means of a switch the operator can cut out his own receiver, so as to avoid annoyance, and by eliminating the back stroke there is no click in the receiver. By the use of a reed, the pitch of which may be varied, the operator is enabled to work through wires located in swamps and circuits which have actually been severed. The battery is inside the leather case, and the size of the whole outfit is $7 \times 7 \times 7$ inches. In the center of the illustration is shown the "Type D" kit, which is a combination telegraph and telephone outfit. It has a buzzer only, and the whole kit measures $8 \times 5 \times 4$ inches. On the right of the figure is shown a cordless field switchboard, which is built to take from 1 up to 10 circuits. It contains the necessary battery, night signal and drops, which are wired to the lines ahead of cross-connecting keys, of which there are three rows. Any cir-

cuit may be connected with any other circuit by a simple arrangement. The board is substantially constructed, so as to stand field usage, and a 10-drop board measures only 10½ × 9⅛ × 16⅛ inches.

Another very interesting contrivance designed and constructed on lines indicated by a board of Signal Corps officers is the portable field electrical signal light, which was also on exhibition. In addition to its primary use as a signal light it also serves as a searchlight. The lines of construction are such as to insure efficiency of action, economy of power and readiness of transportation, all essential qualities for campaigning. A number of these outfits are now in the Philippines, and can be readily transported. It can be easily mounted at any point so that it can be used for searching battlefields for dead and wounded, or as a screen for intrenching operations at night, or for reconnoitering purposes on armored trains, or for columns in the field. One carriage carries the boiler, engine and dynamo, while the other carries the light proper.

ELECTRIC FURNACE.

An electric furnace exhibited by Mr. Otto T. Louis, consisted of several terra cotta cylinders about 2 inches in diameter and ½ inch thick, around which is wound platinum wire of No. 22 B. & S.



ELECTRIC FURNACE.

gauge. The wire is put on in four circuits, so that as the resistance increases with the heat, the circuits may be thrown from series to parallel. The cylinders have longitudinal and vertical motors, and are held in position by clamps.

WAVE FORM INDICATORS.

Mr. L. T. Robinson showed a wave-form indicator, consisting of a small synchronous motor in connection with suitable commutating devices used for determinng the wave shapes of alternating current. An alternating-current tracer shown by Mr. Fitzhugh Townsend differs from the usual instantaneous contact device in that the contact is made during one-half the period.

FLOATING MAGNETIC FIELD.

Mr. E. T. Schoonmaker showed one of the remarkable magnetic phantoms of which he has devised a number of beautiful forms. In this case there are several phantoms on parallel panes of glass which are illuminated from below. The effect is that of a field in space, the particles of iron appearing to be in radial suspension about the pole.

TELEPHONE TO ASSIST HEARING.

Mr. M. R. Hutchison exhibited a form of telephone for the use of persons of defective hearing, consisting of a combined receiver and transmitter to which current is supplied by a small storage battery of a convenient form for being concealed on the person. The sounds received are intensified by the transmitter and the vibrations therefrom conducted to the ear through tubing.

RADIOGRAPHING ALTERNATING-CURRENT WAVES.

Professors H. J. Ryan and J. A. Phelon exhibited an apparatus for securing stationary and continuous diagrams of cards of alternating-current waves. The waves are conveniently recorded by means of a simple form of pantagraph which is run over a luminous diagram and operates a lead pencil.

COPPER SPLICING MACHINE.

Mr. H. F. Sanville showed a portable and self-contained splicing press with independent pump and flexible hose, used for making a solderless splice in wires and cables in the form of a cold weld. The machine has a pressure capacity of 20 tons per square inch in the weld.

FARADMETER AND RESISTANCE BRIDGE.

Mr. E. V. Baillard exhibited a bridge for measuring low resistance and a faradmeter. The latter instrument embodies in practical form the well-known Wheatstone bridge method of comparing capacities. Instead of employing a galvanometer, a telephone in connection with a small vibrating make-and-break is used.

SWITCHBOARD PANELS.

Mr. H. P. Davis showed two switchboard panels containing a phase-shifting transformer, a power factor indicator, a synchronizer, an alternation meter and various new indicating and integrating instruments.

ELECTRICAL MEASURING INSTRUMENTS.

An exhibit by Mr. Caryl D. Haskins consisted of a power-factor indicator, showing the relation between real and apparent energy in an alternating-current circuit; and a single-coil astatic instrument, which, instead of having four coils as usual, employs but a single coil. An ohmmeter was shown by Mr. Otto T. Louis, having a range from 10,000 to 10,000,000 volts.

STORAGE BATTERIES.

Several types of the chloride storage battery were shown by Mr. Herbert Lloyd, and also specimen plates. Included were cells for vehicle purposes, and a special form of cell designed for traction purposes as used on the Thirty-fourth Street Cross-Town Line, New York City.

Mr. A. I. Hubbard exhibited types of cells and plates of the Gould storage battery. The principal feature of this battery is the increase of superficial area of the plate obtained by spinning or grooving with rotary knives, which force the lead up between them, forming ribs and grooves of any desired dimensions. Each rib is made independent by tying the ends with the main cross-bars, and not depending on any center conductor or support, thus giving a low internal resistance. Positive and negative plates were shown, having small amounts of active material, which have gone through a series of charges and discharges, at half-hour and 20-minute rates; an automobile battery cell with a "spinning" giving 450 square inches of surface per pound of lead; a positive and negative plate of the automobile type of cell; and an unformed plate with delicate "spinning," giving 144 square inches per cubic inch of lead.

A storage battery made upon the unit system was exhibited by Messrs. Frank Perret, J. A. Barrett and W. H. Meadowcroft. Cells of different sizes are built up of standard units of definite capacity. The formation is purely Planté, no oxydizing agents being used, and nothing but pure sulphuric acid and water employed at every stage.

MISCELLANEOUS.

An electrolytic magnesia arc lamp on the Nernst principle, and operating at 1000 volts, was shown by Professor W. S. Franklin. Professor Frank A. Lows exhibited radiographs of alternating-current wave forms, made by the use of cathode ray tubes of the Braun pattern. Mr. H. R. Palmer showed in operation the fac-simile picture telegraph which was described in our issue of April 13. A Röntgen ray outfit was shown by Mr. Martin P. Rice, which included a modified form of Wehnelt interrupter. A 55-cm Wimshurst machine, shown by Mr. Otto T. Louis, was operated in connection with the exhibit of Professor H. J. Ryan. The American Institute of Electrical Engineers had on exhibition the handsomely engrossed resolutions, prepared for presentation to the British Institution of Electrical Engineers in recognition of numerous courtesies extended during the visit of the Institute last year to London.

General Electric Annual Report.

A forecast has already appeared in these pages of the annual report of the General Electric Company, which has now been confirmed. The report of the company for the fiscal year ended Jan. 31 shows profits, including $419,066 from the sale of securities, and after deducting all expenses and allowances for depreciation and losses, of $6,243,792. Dividends on the preferred and common stock and interest on debentures were $1,968,289, leaving a balance of $4,275,502, which has been carried to surplus account. The previous balance was $2,353,031, making the present surplus $6,628,533. The orders received during the year aggregate $27,969,541, against $26,323,626 the previous year and $11,170,319 in the year ended Jan. 31, 1897. The number of employees in all the works of the company is over 12,000. There were expended in the year for new patents, patent expenses and patent litigation, $360,259.

The patents and good will of the Siemens & Halske Electric Company of America, the Marks Enclosed Arc Lamp Company and various other manufacturing concerns were acquired at a cost of $604,672, making the total expended on this account $964,931. In the last previous annual report patents, franchises and good-will were carried at $2,000,000. The bookkeeping profit of the difference between the par of $3,763,000 debentures and $3,124,300 par of common stock issued therefor was credited to patents and good-will. The amount is $618,057. There was written off on the same account $346,874, a total of $964,931, leaving the patents, franchises and good-will standing on the books at the end of the year $2,000,000, the same as at the beginning of the year. The three plants of the company now occupy 180 acres, and the total factory floor space of the buildings is approximately 2,362,000 square feet. The book value of these plants is $1,858,044, which is less than 80 cents per square foot of all the manufacturing floor space.

The constantly increasing business of the company necessitates continuous large expenditures on its plants to increase manufacturing capacity. On Jan. 31, 1893, the book value of the three factory plants was $3,958,528, and in the eight years ended Jan. 31, 1900, additions of lands, buildings and machinery were made, at a total cost of $6,127,770, making total book cost of the plants $10,086,299. Within the same period there has been written off for depreciation $6,686,297, leaving their book value on Jan. 31, 1901, at $3,400,002. No change has been made in the book valuation of securities held since Jan. 31, 1897. Securities for which there was no special reason for holding permanently have been sold for $1,070,272. They had been carried on the books at $651,205, showing a profit of $419,066. The proceeds of the sales mentioned were used to protect and improve existing investments to the extent of $1,126,416.

An allowance of $404,131 has been made for possible losses on bills receivable. The amount of sales billed to customers during the year exceeded $28,000,000, and during the last three months they aggregated nearly $9,000,000. Of the 12,600 regular customers on the books of the company, there were debit balances against 4,900 at the close of the year. The cash collections exceeded $26,500,000. Notes and accounts receivable at the beginning of the year footed up $7,314,930, of which all but $516,429 have been settled. The allowance for possible losses on old debts was $228,888, and for the current year $175,243, a total of $404,131. In the balance sheet raw materials have been valued at the lowest price paid by the company during the last three months of the fiscal year. The market price on Jan. 31 last was used where it was lower than the price paid by the company during the previous three months.

The consolidated balance sheet as of Jan. 31, 1901, shows:

Assets—		
Cash		$2,373,683
Stocks and bonds	$6,012,300	
Real estate (other than factory plants)	522,453	
Notes and accounts receivable	9,596,940	
Work in progress	1,054,659	
	$17,186,352	
Merchandise inventories—		
At factories	$7,061,751	
At general and local offices	865,326	
Consignments	63,903	
	7,990,980	
		25,177,332
Factory plants	$3,400,002	
Patents, franchises and good-will	2,000,000	
		5,400,002
Total		$32,951,017
Liabilities—		
Five per cent gold coupon debentures	$1,534,000	
Accrued interest on debentures	12,783	
Accounts payable	820,450	
Unclaimed dividends	3,750	
		$2,370,983
Capital stock—		
Seven per cent cumulative preferred	$2,551,200	
Common	21,400,300	
		23,951,500
Surplus		6,628,534
Total		$32,951,017

The consolidated profit and loss account as of Jan. 31, 1901, shows:

Payments—		
Cost of sales		$23,585,860
Interest on debentures		240,040
Dividends paid—		
On preferred stock	$178,584	
On common stock	1,549,665	
		1,728,249
Surplus at commencement of year	$2,353,031	
Undivided earnings during the year now added to surplus	4,275,503	
Balance Jan. 31, 1901 (surplus)		6,628,534
Total		$32,182,683
Earnings—		
Balance Jan. 31, 1901 (surplus)		$2,353,031
Sales	$28,783,276	
Royalties and sundry profits	298,366	
		29,081,642
Dividends and interest received on stocks and bonds owned	$232,041	
Interest and discount	96,902	
		328,943
Profit on sales of stocks and bonds		419,067
Total		$32,182,683

The balance sheet shows that the company's cash on hand in excess of all liabilities, securities, real estate other than plants, notes and accounts receivable, work in progress and merchandise are $1,225,000 in excess of the capital stock outstanding. The company has no notes payable nor is there under discount any paper bearing the company's indorsement or guarantee. Since January, 1895, the company has not borrowed any money, nor at any time since that date has its credit been used either by issuing notes, indorsing customers' paper for discount or lending its name in any way; but by adhering to its established policy of maintaining sales on a basis of cash or short credit to desirable customers, all purchases have been paid for in cash. On Jan. 31, 1900, there were outstanding $5,300,000 debentures. There were purchased for cash (average price $1,270.83) during the year, $3,000, leaving $5,297,000. Surrendered and exchanged for common stock at $120, debentures at $100, $3,763,000, leaving debentures outstanding, $1,534,000.

CURRENT NEWS AND NOTES.

THE CUNARD COMPANY has, it is said, decided to install the Marconi wireless system of telegraphy on its steamers.

ISOLATED PLANTS IN BOSTON.—The Wire Department of Boston reports that at the end of last year there were 271 isolated plants in the city, in which there were 466 generators having an aggregate capacity of 18,205 kilowatts. These plants supply current to 714 motors, aggregating 6257 horse-power; to 193,091 incandescent lamps and 3297 arc lamps.

MR. G. MARCONI called upon the United States Navy Department in Washington last week and saw Secretary Long.

MORE FRENCH SUBMARINE BOATS.—The French Minister of Marine, M. de Lanessan, has ordered the construction of 20 additional submarine boats.

MINING LOCOMOTIVES.—It is stated that there are now more than 250 electric mining locomotives in regular operation in the State of Pennsylvania alone.

WIRELESS TELEGRAPHY IN CORSICA.—A recent Paris dispatch conveys the information that a system of wireless telegraphy has been established along the coast of Corsica for a distance of 124 miles. The masts used are 120 ft. high.

MR. ISAAC L. RICE, at the request of a large majority of the stockholders, has agreed to accept the presidency of the Consolidated Railway Lighting & Refrigerating Company, and John N. Abbott the position of vice-president and general manager.

NEW YORK ELECTRICAL SOCIETY.—The New York Electrical Society will hold its next meeting at Havemeyer Hall, Columbia University, Thursday, April 25, when Mr. C. F. Scott, chief electrician of the Westinghouse Electric & Manufacturing Company, will lecture on alternating-current motors.

LIGHTING ST. PETERS.—A special cable dispatch from Rome, speaking of Easter in the Eternal City, says: The newly installed electric lighting plant at St. Peter's was inaugurated this evening. The effect was most brilliant. There were 80,000 spectators present, including many tourists.

WIRELESS TELEGRAPHY IN HAWAII.—The steamer Upolu, a small interisland vessel, was reported recently on the reef at Puku, Hawaii. The news was sent to Honolulu by wireless telegraph from Maukona, which would imply that the system is now in regular working order in the Sandwich Islands.

CHICAGO TICKER SERVICE.—The contract between the Chicago Board of Trade, the Western Union and the Postal Telegraph companies provides that these two companies and the Cleveland Telegraph Company shall receive the quotations simultaneously by means of one Morse instrument on the floor of the exchange. The sum paid by the telegraph companies jointly for the quotations is $30,000 a year. The contract runs for one year and provides for the termination thereafter upon 60 days' notice by either party.

THE GROWTH OF THE TELEPHONE.—General Sabin, president of the Pacific States Telephone Company, which company holds the records for Bell telephone progress, wires as follows: "We will close March with 24,000 central stations in San Francisco, making a net gain of over 1500 for the month, in addition to which we have 500 unfilled orders. This telephone business needs, first, general consolidation, general enthusiasm, fewer high-class blue prints and more common, every-day arithmetic, fewer wheel horses to hold back in the traces and more broncos to put in the lead. For your information, a bronco is a wild Mexican horse that it takes 14 men to hitch up, and when once started he never goes at a walk until he dies."

APPOINTMENTS IN UNITED STATES SIGNAL CORPS.—The following appointments have been made in the Signal Corps, regular army, subject to a physical examination: To be captains, Edward B. Ives, Eugene O. Frecht, Gustav W. S. Stevens, Daniel J. Carr, Leonard D. Wildman, Charles McK. Saltzman, Otto A. Nesmith, Carl F. Hartmann, Benjamin F. Montgomery, Charles B. Hapburn. To be first lieutenants, Frank E. Lyman, Jr., George C. Burnell, Henry W. Stamford, Basil O. Lenoir, Charles S. Wallace, William Mitchell, Walter L. Clark, George S. Gibbs, Richard O. Rikard, Henry S. Hathaway, Alfred T. Clifton, Charles B. Rogan, Charles de F. Chandler, Mack K. Cunningham.

THE CABLE TO MANILA.—A special dispatch from Washington says: The report from Manila that the cable ship Burnside is to continue to lay cables in the Philippines, connecting the islands with Manila, revives interest in the protest made by the Eastern Extension Company, which controls the cable from Hong Kong to Manila, against the laying of cables in the islands. This protest was considered by the State, War and Justice departments of this Government, and it was determined, after an opinion by the Attorney General, that the reservation which the Spanish Government made when it granted to the Eastern Extension Company exclusive rights in cable construction allowed the United States Government to continue its cable construction. This reservation provided that the Spanish Government could lay cable for State purposes. As the cable being laid by the War Department was for the use of the military authorities in governing the islands it was the opinion that it meant the same as "State purposes" in the Spanish concession. The cable company concession was granted just before the American-Spanish war, and runs for 40 years.

FREQUENCY OR SPEED INDICATOR.—An instrument for indicating the speed of an electrical generator or the frequency of an alternating current, is the subject of a patent issued April 9 to R. D. Mershon. A voltmeter has its terminals connected to the terminals of a choke coil placed across the working circuit. The core of the choke coil has such a section that the iron will be worked at some point above saturation. In series with the choke coil is a resistance of such value that the drop between its terminals relative to that between the terminals of the choke coil is so great that the former substantially governs the amount of current which shall flow through the indicator circuit. In the case of a constant voltage the amount of current flowing through the choke coil and ohmic resistancies will be substantially constant, and the voltage across the terminals will vary approximately as the frequency of the current passing through it and, therefore, approximately as the speed of the generator; consequently, the voltmeter may be calibrated to indicate approximately the frequency or speed. To secure a still more accurate indication there may be included in series with the resistance the primary winding of a small transformer, the iron of which is worked not above, but below, saturation. The secondary coil of this transformer is so connected with one terminal of the choke coil and with one terminal of the voltmeter as to oppose the voltage which the voltmeter receives from the choke coil. This transformed voltage serves to change the voltage at the terminals of the voltmeter in such a manner that a curve thereof will approximate very closely to a straight line substantially parallel to the co-ordinate axis of current. It therefore follows that any variation in the voltage of the generator will produce substantially no effect upon the voltmeter, which will be influenced only by changes in frequency and speed.

MAINTAINING IN SYNCHRONISM ALTERNATORS IN PARALLEL.—It has been found in practice that when two or more alternators are driven by independent engines there is a tendency for the machines to get out of synchronism, particularly if the generators are of large size. To counteract this tendency C. I. Young, in a patent issued April 9, proposes to employ a combination of centrifugal and inertia governors in such manner that the former will tend to maintain the speed of its engine uniform without regard to the other units, and the latter will control variations from synchronism in speed. The first mentioned governor may be of the usual type which acts to shift the engine eccentric and thereby vary the valve lead. The eccentric strap connects to one arm of a bell crank, the other arm of which has a curved slot in which is mounted the pin of a connecting rod giving motion to the valve stem. On the shaft of the engine is also mounted an inertia governor, which acts upon a link, the outer end of the link being pivoted to the valve connecting rod. Assuming that there are two engines and two generators, if the machines start to go out of synchronism there is a succession of jerks forward on the slow machine and a corresponding succession of jerks backward on the faster machine. Now, the constant jerk forward of the slower machine will cause the weight of the inertia governor to act, the result of which will be to raise the valve connecting rod pin in the curved slot, thus increasing the lead of the valve motion and speeding up the engine. On the other hand, the jerk backward on the fast machine will through its governing means act oppositely on the valve rod of its engine, and thus decrease the lead of the valve motion and reduce the speed of the engine. As soon as the jerks stop, the inertia governors tend to move back to the former position slowly on account of the dashpots, and the main work of regulation is then taken care of by the centrifugal governors.

MR. THOMAS A. EDISON informs us, with regard to the cadmium-copper Edison storage battery illustrated and described recently in these pages, that his complete work in this direction, dealing with its latest developments, will be described by Dr. A. E. Kennelly before the American Institute of Electrical Engineers.

LONDON UNDERGROUND.—A cable dispatch from London of April 13 says: The *Globe* states that the deadlock between the Metropolitan and District Underground railways has been ended, and a contract for the introduction of electricity as motive power has just been signed. It is stated also that uniform fares will be introduced.

CALCUTTA DWELLINGS.—According to a report from Mr. F. R. Patterson, United States Consul-General, the situation in Calcutta demands either the creation of suburbs to be reached by trolley or the erection of modern roomy apartment buildings with American electric fans and elevators, and "all improvements," such as are known in New York.

GERMAN SUBMARINE BOAT.—A cable dispatch from Berlin of April 13 says: The German authorities have been making extensive trials and experiments since March 1 near Lindau, on Lake Constance, with a new type of submarine torpedo boat. The inventor, who is a civil engineer named Gurt, of the Navy Department, preserves silence concerning the result of the experiments, but it has been ascertained that the tests have so far been successful. The boat dives for a short time to a depth of 300 ft.

THE PARIS UNDERGROUND.—The *Figaro* asserts that the Metropolitan Railway has beaten the world's record for the number of passengers carried on any line. From Jan. 1 to March 31 it transported 11,315,700 persons, which, at the same rate for a year, would give a total of 32,000,000, an average of 4,000,000 per kilometer. It carried on Easter Sunday 182,216 passengers, which number was double the biggest day's total during the Exposition.

"INSURANCE ENGINEERING."—This is the title of a new monthly publication issued by the Insurance Press from its offices at 120 Liberty Street, New York City. It bids fair to be a very interesting and useful publication if the first number be taken as a criterion. It contains several valuable articles dealing with subjects of importance from the insurance standpoint, and discussing in each case the engineering features as related to the fire risk and casualty. As might be expected, there are articles dealing with the electrical side of the question, and these are written quietly and temperately, as befits the subject. In the overcrowded field of technical journalism it might seem difficult to strike out a new path, but *Insurance Engineering* may be said, with proper phrase, to have "blazed" one for itself. and we shall be glad to note our new contemporary's success. The editor is Mr. Harry D. Gue.

LETTER TO THE EDITORS.

The Development of Lighting Fixtures.

To the Editors of Electrical World and Engineer:

Sirs:—Although nearly all the veterans of the electric light and power industries have had something to say in the technical press relative to the early days of those useful arts, I have not seen anything on the subject of lighting fixtures, a business which has grown like Jonah's gourd. The output for last year was somewhat more than $2,000,000. In 1882, according to a set of tables, which have been gathered with care, the total output was not much more than $10,000. I can well remember that during the year when the first incandescent lighting plant was planned for New York, two gentlemen, now among the most prominent expert electrical engineers in the country, called upon me for the purpose of obtaining estimates for a few brackets and chandeliers for a downtown banking office. The estimate was accepted, and the goods ordered, and then trouble began for me. My uncle, who was the head of the firm, gave me "the rounds of the kitchen" in vigorous style and denounced the electric light as "a miserable circus humbug, that would never amount to anything." He ended by issuing positive orders that the next inquirers for electric light fixtures were to be most politely and firmly informed that our facilities were overtaxed for gas goods. As ill luck would have it, for me, the next man who turned up was a very warm friend who is now the head of a large corporation in Philadelphia. He, too, wanted some brackets, and I broke the rule and took the order. I made a blunder in the factory order for wiring, and as the goods were not suitable for the purpose for which they were ordered, my uncle "paid me off," as he said, by charging up the bill to my account. For six months thereafter all inquirers for electric fixtures were cordially told to go elsewhere.

During the next year the demand for fixtures began to mean something. I asked for 20 square feet of space for an electric fixture showroom, but was voted down at the directors' meeting. Other makers of gas fixtures were like minded with us, and refused to make electric goods. By 1886 we all began to see that electricity had "come to stay," and that it is was high time for us to wake out of sleep and go in for the good time a-coming. Still, we looked on the electric side of the business as a poor thing. For the gas showrooms we had velvet carpets, decorated walls and richly upholstered sofas and chairs. For the electric room we thought bare floors and painted walls good enough. Customers for gas goods were treated to 20-cent cigars and luncheon at Delmonico's. The electric fellows were treated to 10-cent straight cigars and a snack at the first lunchroom in sight. From time to time, we asked the opinions of the "gas barons" about electricity, and they told us that the electric light was merely a creature of speculators, and that it would never amount to much, except in shops and theaters. Most of the high-class architects for fine houses were then of the same way of thinking.

Finally, a day came when the late Richard Morris Hunt came into our place and said: "I want you to go to Newport to-morrow night and note down my ideas for electric fixtures for so-and-so's house." In three days we booked that order for $15,000. That set things a booming for fine electric fixtures. I spent the whole season with multi-millionaires who were bound to put in the electric light, and at the end of the season we put velvet carpets on our electric light fixture sample rooms, and fitted it up equal to the gas fixture rooms. So with our competitors. All embarked in the fixture business, until the business was overdone.

Fortunately, the business was started on right lines for the development of art in electric fixtures. Alexandre Sandier, then decorative artist for the architects of the William H. Vanderbilt mansion in Fifth Avenue, and now head of the Sevres National Porcelain Works, Paris, and Mr. Charles B. Atwood, afterward the architect of the Fine Arts Building at the Columbian Exposition at Chicago, made a number of magnificent designs for electroliers which set the form for fine electric fixtures in all countries. At that time, there were very few gentlemen in the electric light companies who knew how much money should be spent for fixtures by a man of large fortune. I remember that the late Frederick L. Ames, of Boston, sent to a local electrician to make an estimate for wiring and supplying fixtures for his palatial mansion, which was and is as fine as the finest mansion in Europe. My friend, the electrician, estimated the fixtures at $5,000. "Why," said I. "my dear boy, for a mansion of that sort $5,000 is very small for the lower floors." We finally put in more than $10,000 worth. I remember another case in New Orleans where an electrician figured on $250 for the entire house of a millionaire, where, after the owner had seen my drawings by Mr. Atwood, he paid $5,000 for the fixtures alone.

As the electricians were mostly bright young men of good mental attainments, it did not take them long to learn the fine art points of the fixture business, and by 1888, there were few electricians in the country who were not able to talk eloquently on the Louis XIV., Italian Renaissance, Empire and Adams schools of art in metal. More than this, a number of our leading electricians who are fertile in ideas have developed a school of art in fixtures which, while it has no name, is well recognized abroad as an example of the talent of Young America in dealing with new problems in the art world. I remember a hint dropped by a Boston customer for fine fixtures which led to many new ideas in fixtures. I took him to see a number of remarkably good things of the day—the Henri IV. banquet hall at the Plaza Hotel by Mr. Samuel Insull's company; the Empire Hotel, by Mr. Edward Caldwell, etc. After he had seen all these things he said: "You have shown me a lot of things called after men who have been dead for centuries, now show me something that

is really American. I don't care a cuss for Henry IV. or Louis XIV. or Napoleon." To get at something really American, I took him over to see Mr. Meadowcroft, and the other gentlemen of the General Electric Lamp Works. He saw plenty of American ideas there, and placed his order.

When the work was put up I am sure it was the only genuinely American designed example of electric fixtures in the world. The effects made a sensation. All Boston wondered and came and saw. For months the owner stood a delighted spectator, and whenever I turned up he usually said: "I wonder what your back-number friends, Henry IV., Louis XIV. and old Napoleon, would say if they could rise up and see this outfit of fixtures." The good fellow has been long, I hope, in a better world than this. He certainly gave the spark to a thought that blazed into a school of decorative art in electric lighting which is daily growing more and more in favor, and is departing from the conventional forms of gas fixtures which once dominated the electric fixture field.

Newark, N. J. P. W. George.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

REFERENCES.

Repairing a Generator Commutator.—Weeks.—An illustrated article giving directions on repairing and reconnecting a generator commutator.—*Amer. Elec.*, April.

Induction Motor Armature.—An explanatory article with diagrams showing the action of an induction motor armature or rotor, and giving formulæ for calculating the e. m. f., torque and frequency.—*Amer. Elec.*, April.

Power.

Electrically-Driven Machine Tools.—A description of machine tools devised by Kodolitsche, the director of the Lloyd Arsenal in Austra. His boring drills are all modifications of a single type. An electric motor is mounted upon a revolvable vertical bearing, which is supported on a horizontal axis. Motion is transmitted from the motor to the working tool by means of a telescopic shaft universally jointed to permit of the tool being turned in any desired direction the tool itself may be fastened to the work by ordinary clamps or magnetically attached to the work by means of electromagnets. His riveting machines are constructed as follows: The driving electric motor carries an electromagnet around in its revolutions, and when current passes through this movable magnet it engages a metallic mass, which is placed in front of the electromagnet and by means of a screw provided with a traveling nut, the movement of this metallic mass results in operating the movable header of the riveter. At the precise moment when the contact with the rivet should take place the electromagnetic contact is automatically released, but the accumulated operative energy in the metallic mass is translated into a pressure upon the head of the riveter capable of producing the desired head on the rivet, whereupon the movable parts automatically replace themselves and the machine is ready to operate upon the next rivet.—*L'Etincelle Elec.; El'ty*, April 3.

Packing-House Power Equipment.—An illustrated article on the alternating-current power equipment of some packing houses. All the various factories are supplied from one central station. One of the stations supersedes 11 isolated steam plants formerly used to generate power for the 48-acre packing plant. Arc and incandescent lamps and induction motors are all supplied from a common generating source.—*Amer. Elec.*, April.

Electric Installation of a Glass Manufacturing Plant.—Farnham.—An illustrated description of the power plant of the Edward Ford Plate Glass Company, of Toledo, Ohio. All of the machinery for grinding and polishing the glass, and all the smaller auxiliary machinery is driven by electric motors. The power plant has a capacity of 5200 horse-power. In all there are 83 motors with an aggregate horse-power of 7043, 59 of these, including 18 of 200 horse-power each, and 24 of 100 horse-power each, and aggregating 6754 horse-power altogether, are of the three-phase induction type, and designed for a current of 580 volts, with a frequency of 80. The remaining 24 motors, with an aggregate horse-power of 289, use direct current at 120 volts; 15 of these are special crane motors.—*The Eng.*, April 1.

Speed Regulations of Electric Motors.—Wheeler.—A brief article in which he says that "the electric motor's regulation and control are the most valuable of all its good attributes. It is unique and remarkable in the accuracy, scope and adjustability of its regulation. It maintains a speed which is nearly constant, and is not deranged by great overloads. It may be adjusted to run with a constancy of speed within any limit of precision,and its action swings about this fixed speed as a center, its activity increasing as a motor if it is slowed down by heavy load and becoming that of a dynamo and reversing the demand for current if speeded up by the application of extra power. It achieves this remarkable regulation when made in the simplest form, and without any governor, valve or other apparatus."—*Cassier's Mag.*, April.

Diesel Engine.—Some editorial notes on the exhibition of the first Diesel engine, made in England. "The essence of the Diesel internal combustion engine is the Diesel cycle, and the essence of this cycle is—high compression. Everything else about the engine—whether in its Continental four-stroke or in its more recent Brtish two-stroke arrangement—is incidental to the realization of this high compression in an actual gas or oil engine."—Lond. *Elec.*, March 29.

REFERENCES.

Fan Motors.—A profusely illustrated article on the different fan motors for the year, with details of their construction.—*Amer. Elec.*, April.

Direct-Current Fan Motor.—An illustrated article with working drawings and directions for the construction of a direct-current fan motor.—*Amer. Elec.*, April.

Polyphase Sub-Station Machinery.—Eborall.—The first part of a Brit. Inst. Elec. Eng. paper, in which he gives "Some notes on polyphase sub-station machinery." In this part he deals with the general ideas underlying the equipment and operation of sub-stations for lighting or traction. He discusses at great length the use of asynchronous motor generators, synchronous motor generators and rotary converters.—Lond. *Elec.*, March 29.

Drilling Machine.—An illustrated description of a new electrically-driven portable machine, made by a British firm, for drilling holes up to 2½ inches in diameter.—Lond. *Elec.*, March 29.

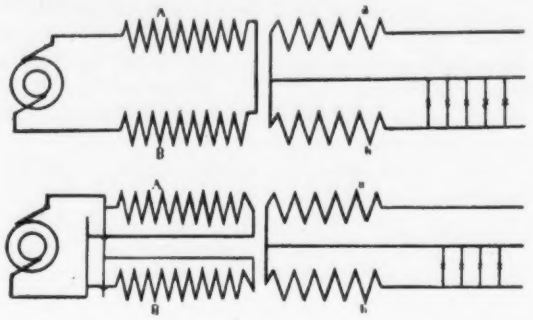
Steam Engine Efficiency.—Nagle.—A letter defending the use of the Mariotte expansion curve as a basis for comparison in determining the efficiency of an engine.—*Amer. Elec.*, April.

Water of Condensation.—Obert.—An illustrated article on the cause and dangers attached to water of condensation, together with methods of preventing its accumulation and withdrawing it.—*Amer. Elec.*, April.

Installations, Systems and Appliances.

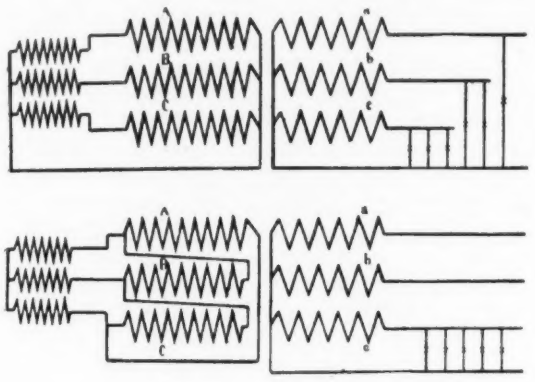
Transformer Connections.—Dolivo-Dobrowolski.—A paper read before the Electrotechnical Society, of Berlin. In single-phase and three-phase systems, in which relatively few consumers on large areas are to be supplied with light, and in which one does not want to use too many small transformers, it is often desired to use a system similar to the three-wire direct-current system. This leads to the use of so-called "neutral" conductors. In the three-wire single-phase system there are some difficulties in the transformer connections. If there are two cores and the connections are made as in Fig. 1, a great difference of voltage occurs when the loads on the two halves of the system are unequal. For instance, if the load on coil *b* is greater, the current in the high-tension coil *B* ought to be larger also, but this current cannot be obtained in sufficient amount, as it would also flow through the coil *A*, which, however, has only a light load, hence we get an entirely unsymmetrical distribution of the magnetizing and demagnetizing forces, therefore

also unsymmetrical straying. The result is that the voltage in *b* decreases and that in *a* increases. The differences of voltage if only one side is fully loaded, may attain 50 per cent or more. He recommends the following simple and interesting remedy, which he has used in installations of the Gen. Elec. Company, of Berlin. He calculates both high-tension coils for the full high-tension voltage, and connects them in parallel, as shown in Fig. 2. The load in the halves *a* and *b* may be entirely different, but the voltage drop is the same whether the load is only on one-half, or is symmetrical. He has found this to be correct in practice. A somewhat analogous arrangement can be used for three-phase currents. The system shown



FIGS. 1 AND 2.—TRANSFORMER CONNECTIONS.

in Fig. 3, in which the lamps are connected between the three phases and the neutral wire, is well known, but it has generally been used only for low-voltage installations. For those of high voltage, with transformers, the consideration of the balance of the voltage required one to use a neutral wire, starting from the central station. This was a very great disadvantage. He shows that it is not necessary to let the neutral wire start from the central station. His arrangement is very similar to that for single-phase systems, described above, and is shown for three-phase systems in Fig. 4. This arrangement has been used by his company for 1½ years with good success. For all practical purposes it is sufficient to make the neutral wire half as thick as the outers, just as in the direct-current sys-



FIGS. 3 AND 4.—TRANSFORMER CONNECTIONS.

tem. A transformer connection, in which one side has star connection, the other ring connection, is called by him a "fixed" connection, while one in which both sides are connected either in star or in ring, is called a "normal" connection. It is said to be necessary to use different names, as a transformer with mixed connection cannot work in parallel with a transformer with normal connection. Transformers with mixed connection can be connected in parallel among themselves, also transformers with normal connection among themselves. His company paints the transformers with normal connection with a different color than the transformers with mixed connections.—*Elek. Zeit.*, March 21.

REFERENCES.

Diagrams of Electrical Connections.—Diagrams showing the connections for storage batteries with modified compound and differential boosters.—*Amer. Elec.*, April.

Pan-American Exposition.—An illustrated article describing the fountains to be used and the method of their illumination, together with the general lighting plan to be carried out at the Pan-American Exposition at Buffalo.—*Amer. Elec.*, April.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Interior Wiring.—KNOX.—An article with plan drawings devoted to the consideration of the characteristic features of the electric light wiring of a modern hotel.—*Amer. Elec.*, April.

ELECTRO-PHYSICS AND MAGNETISM.

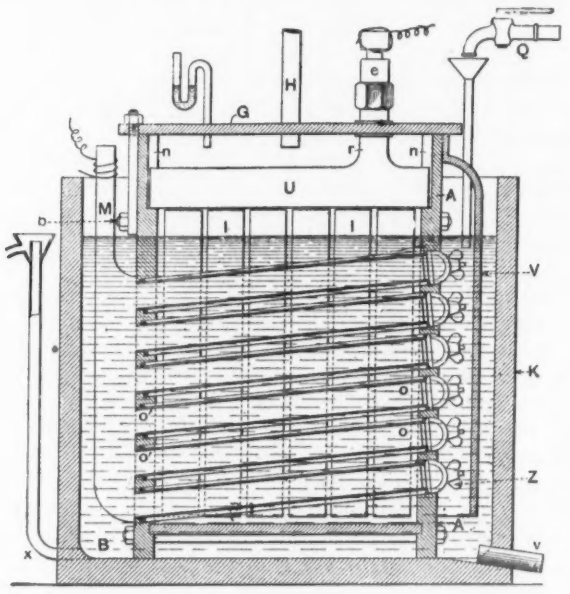
Distribution of Current Over Two Cathodes.—WEHNELT.—In exhausting cylindrical vacuum tubes containing circular cathodes nearly filling up the cross-section, the observation has been made that the cathode and canal rays which at high pressures fill up the whole tube, are gradually driven away from the walls until nothing remains but a thin pencil or rays along the axis of the tube. "This observation suggested to A. Wehnelt that a considerable diversity should exist in the current intensity traversing different parts of the same cathode, and to find whether this was the case he constructed composite cathodes consisting of a central plate and a guard ring round it. He found that in such cathodes the current only flows through the parts covered with visible rays. In the case of oscillating currents, it even happens that he guard-ring acts as an anode, while the central plate acts as a cathode. The cathode rays only proceed from those parts of a cathode from which luminous rays proceed also. When concave electrodes are used, the current density is the same on the inner and the outer surface. If two cathodes of equal area are contained in the same tube, the current flows mainly through the cathode, showing the least drop of potential. Impurities have a great disturbing effect, but unevenness of the cathode only at high pressures."—*Phys. Zeit.*, March 2; abstracted in Lond. *Elec.*, March 29.

REFERENCE.

Electromagnets and Solenoids.—An article with diagrams and tables giving the lifting power of magnets at different pole-face densities, together with a discussion on the various forms of solenoids.—*Amer. Elec.*, April.

ELECTRO-CHEMISTRY AND BATTERIES.

Alkali Process.—KERSHAW.—An illustrated description of the Outhenin-Chalandre electrolytic alkali process. It is for the production of alkalies and chlorine compounds by the electrolysis of solutions of sodium or potassium chloride, and belongs to the diaphragm class. It is in actual operation in Switzerland and France. The adjoining figure is a sectional elevation of the cell. It "consists of an outer vessel *K*, and of an inner vessel *A*, entirely closed and built of materials unacted upon by chlorine gas or its compounds. This inner vessel is filled with rows of porous-diaphragm tubes *o o*, open at each end to the outer chamber *K*, of the cell, and inclined at a slight angle, as shown in the figure. Each



SECTIONAL VIEW OF CELL.

tube is hermetically sealed into the walls of the chamber *A* by a special device shown at *Z*, and contains an iron sheet cathode running the whole length of its interior. These sheet cathodes are joined to a common terminal at *M*, and each vertical row of diaphragm tubes is thus served with current by the one electrical

contact to the main supply. The anodes *I* are round rods of specially prepared carbon, fixed into the common lead head-piece *U*, and communicating at *e* with the negative terminal of the dynamo. They hang vertically in rows of seven between the rows of diaphragm tubes, and the chlorine evolved at their surface collects in the upper portion of the anode chamber, and is carried away by the outlet pipe *H*. The right-hand side of the inner cell is provided with a sheet-iron movable hood *V*, and outlet pipe not shown in the figure. This serves to collect and carry away the hydrogen liberated within the diaphragm tubes and facilitates its utilization for other purposes. The cell is operated in the following manner: The inner chamber *A* is nearly filled with a concentrated solution of sodium chloride, and the outer vessel with a dilute solution of sodium hydrate. The electrical connections are then made. The chlorine gas liberated within the chamber *A* passes off by the pipe *H*, and is used for the manufacture of bleaching powder or for some other purpose. The sodium liberated at the surface of the sheet-iron cathodes decomposes the water present, yielding hydrogen gas and a solution of sodium hydrate. The first travels up the tubes and escapes into the collecting chamber *V*, whence it passes to a gasholder for storage until required. The solution of sodium hydrate, owing to its higher specific gravity than the surrounding solution, travels down the tubes, and collects on the bottom of the outer chamber of the cell. Since the cell design permits the hydrogen to pass away with a minimum disturbance of the electrolyte in this outer chamber, fairly concentrated solutions of sodium hydrate can be obtained, and when required are run off by the outlet pipe *v*." The advantages of this cell are complete separation of the electrolyte in the anodic and cathodic compartments of the cell, and collection and utilization of the hydrogen liberated at the cathodes. The disadvantages are the high e. m. f. due to the diaphragm, and a very complicated structure. That the cell has been operating in the Swiss plant since 1899 with satisfactory results is proof that under certain conditons the advantages outweigh the disadvantages. A modification of the process is described, in which the liberation of oxygen and oxygen compounds with the chlorine at the anode is suppressed.—Lond. *Elec.*, March 29.

Aluminum Electrode.—BARTORELLI.—An investigation of the fact that an aluminum electrode in a voltmeter allows a much stronger current to pass when it acts as a cathode than when it acts as an anode. It is not yet certain whether this is due to a layer of silica or of aluminum oxide. His researches do not decide this question but give valuable information concerning the polarization and the internal resistance of the voltameter in terms of the current traversing it.—*Nuovo Cimento*, Feb.; abstracted in Lond. *Elec.*, March 29.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephonic Transmission.—WIEN.—If human speech is to be transmitted with complete clearness and distinctness, every constituent frequency must be reduced (attenuated) in the same proportion, if at all. "That the telephone does not do this is due to the fact that the effective resistance increases with the frequency, while the magnetic induction decreases. This has a serious effect upon distinctness, especially as the frequency of the constituent sounds of human speech vary between such wide limits as 16 and 10,000 vibrations per second. Another complication is introduced by the natural period of the telephone disk. According to Max Wien, a Bell telephone reinforces the notes of 1100, 2800 and 6500 vibrations per second, and several higher pitches as well. A Siemens telephone has two successive maxima at 5000 and 5400. The most characteristic notes of the human voice lie between 500 and 3000, and for these notes the telephones of Bell, Apel and Siemens are equally sensitive. For higher notes, the sensitiveness often shows remarkable differences. Thus a modern Siemens and Halske telephone will transmit the note 4000 nearly 100 times as loudly as a Bell telephone. The author used an alternate-current siren for these investigation." —*Ann der Physik*, No. 3; abstracted in Lond. *Elec.*, March 29.

Wireless Telegraphy.—GUARINI.—A brief communication on his experiments, noticed before in the Digest. He found "that the employment of alternating currents is preferable to the employment of Hertzian currents." There is also a brief note on a letter from Poncelet, who considers that the object of Guarini's experiments was actually attained, as signals transmitted from Brussels were successfully received at the repeater station and retransmitted by the apparatus to Antwerp. During the last days of the experiments the only failures occurred in the receiving part of the repeater.—Lond. *Elec.*, March 29.

REFERENCE.

Common Battery Telephone Switchboard Systems.—HENRY.—An article on common battery telephone switchboard systems, with diagrams of connections.—*Amer. Elec.*, April.

TRACTION.

The Ganz System in London.—An editorial commenting on the proposed equipment by Ganz & Co. of the present steam underground railway in London with alternating-current motors. The contract has not yet been awarded. The bid was said to be $1,000,000 lower than that proposed by American manufacturers, all of whom bid on direct-current motors, with rotary converters. The writer refers to the successful results, which are said to have been secured on small roads with alternating-current motors, and welcomes the introduction of the system on such a large scale as in London. If the results are satisfactory, it will mean quite a change in existing methods, while if unsatisfactory, the fact will be clearly determined. There seems to be no difficulty in taking current from working conductors at very high voltages or of winding induction motors for several thousand volts. This makes the polyphase system preferable so far as the cost of conductors is concerned. There are a number of problems yet to be worked out as regards the speed control of motors, but it should be remembered that the present series parallel system of controlling direct-current motors was originally very crude and was only brought to its present perfection by many years of careful and persistent work. One cannot be justified, therefore, in predicting failure for the proposed method of controlling the speed of polyphase motors. Other problems may arise, but can only be determined by actual experiment.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Electric Traction for Heavy Railroad Service.—BURCH.—A paper read before the Northwestern Railway Club. The writer quotes tests of tractive coefficients of the Baltimore & Ohio electric locomotives as showing 30.8 per cent as against 20.6 per cent for steam locomotives under the same conditions. A reduction in weight of 50 per cent of the electric locomotive over the steam locomotive can be made to secure the same service. The statistics of all the steam roads in the United States show the following operating expenses: For repairs of roadway, 10.72 per cent; for repairs and renewals of locomotives, 6.2 per cent; for water of locomotives, 0.62 per cent; for engine and roundhouse men, 9.69 per cent; for fuel for locomotives, 9.45 per cent. The first item will be largely reduced by electric locomotives, as the driving wheels are perfectly balanced. The second item will be reduced from 60 to 75 per cent by the use of electric locomotives. The third item will disappear entirely and a large reduction will be made in the fourth item. The writer then discusses the fifth item at considerable length, and concludes that here a saving of 65 per cent in coal used per horse-power generated, or 53 per cent in horse-power used for traction will be secured. In the discussion some figures as to the amount of coal used by steam locomotives showed it to vary from 900 lbs. to 1300 lbs. per 10,000-ton miles for freight service and 1500 lbs. to 2200 lbs. for passenger service. The locomotive under various severe service evaporates from 5¾ kg. to 8 kg. of water per kg. of coal.—*St. R'y Jour.*, March 9 and 30, and Int. Ed., April.

Electric Railways.—CARDEW.—An abstract of the last of his three Cantor lectures. He arrived at the conclusion that for the case of railway work on an extensive scale and necessitating transmission of electrical energy to a distance, polyphase generation and distribution are to be preferred. The points in favor of it are the simplification of the sub-stations, the possible use of much higher pressures (3000 volts) for the motors on the train. The currents to be carried being less at this high pressure, the sub-stations could be further apart, and the rail return would be replaced by a copper strip on fairly insulating supports. These and other advantages, including the simplification of the motors and the possibility of suspending their rotors entirely on springs, quite counterbalanced the advantages of direct current, such as the saving of one conductor, the reduction of plant capacity, by the use of storage batteries, the absence of idle currents, estimated as amounting to a waste of 15 per cent in polyphase working, and the wider permissible variations in speed. He gave the general design of an electric railway line extending 50 miles, with a large load traffic at one end and a small local traffic at the other. He explained an ingenious time table, in which slow trains traversing sections of the main line between the times of the half-hour express trains, resulted in an almost ideally quick and frequent service between all points.—Lond. *Elec.*, March 29.

New Method of Rating Street Railway Motors.—AMRSTRONG.—The writer first advocates the rating of motors by tests of actual operating conditions rather than under continuous loads. He then considers the current required to give different speeds, and shows some acceleration curves. The losses in watts in different parts of the motor are shown. In these the watt losses in the field are the same as those in the armature when the runs are very short. To properly rate a motor it is necessary to know the degrees of temperature rise per watt loss in the field and the armature, and these data are of value only when they are obtained under the conditions of ventilation found in practical operation. Thus, with the motor stationary while it is tested, the ratio of the heat produced in the armature to that of the field would be much greater than when the armature was ventilated by contact with a current of air, as when in service. The writer then criticizes the position taken by Storer in an article on motor rating in the January issue of that journal, and states that under different conditions of speed and operation, different ratings would be given to the same motor by the Storer method. In other words, he recommends that speed should always be considered.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Electric Railway at Georgetown, British Guiana.—The site of this town is on soft, blue clay, with only about 4 inches of hard surface, mostly the macadam of the streets. This makes it very difficult to construct foundations for heavy buildings and machinery such as are required in electric railway operation, and even the setting of poles is a difficult matter. The line in the town has recently been built by a Canadian syndicate, and as the telephone system in the city was owned by the Government, a number of difficulties were encountered. The telephone wires all had to be raised to clear the trolley wires, and fuses were required on each subscriber's line and at the exchange. The guard wires for the trolley system had to be earthed wherever the trolley wire passed the telephone wires. The company also supplies electric lighting, and for its railway equipment has one 200-kw and one 100-kw generator. The foundations are of concrete, and are carried down to a depth of about 5 ft., and the base of the foundations is extremely broad. In setting the poles a cone-shaped hole was dug about 2½ ft. in diameter at the top, 3½ ft. in diameter at the base and 5 ft. deep. The poles were then set on wooden blocks about 3 inches thick and 20 inches square. Concrete was then packed around the poles. Even under these conditions the poles sometimes become loose, and this can only be overcome by frequent tamping and guying. There are about 10 miles of track. The road is laid with a 64-kg. T-rail on metal ties.—*St. R'y Jour.*, April.

Street Railway System of Naples, Italy.—C. PIO.—There are only two short electric lines in Naples which have been in use for any length of time, the first section of the main line having been put in operation only on March 2 this year. Nearly all the lines are owned by one company, the power station of which has not yet been completed so that power is being bought from electric lighting companies. The feeders are laid underground. The two short lines first mentioned have an aggregate length of about 12 km. and a maximum grade of 7.9 per cent. The new power station will contain three horizontal compound condensing tandem engines, each directly connected to a 600-kw generator, and three smaller units, also four direct boosters and five converted boosters.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Michigan Traction Company.—This consists of two city systems, each with about 20 km. of track, and a line connecting the two cities about 44 km. in length. The latter line uses two trolley wires to avoid overhead switches, and a telephone signal system. Each car has a telephone which can be connected by plugs on every fifth pole, and in addition there are stationary telephones at each turn. The cars in the cities are about 18 ft. in length, and those on the interurban line about 45 ft. in length. Power is distributed from the three-phase system from a station about 22 miles distant from one city and 46 miles from the other city. This station has a capacity of 2800 horse-power. Power is distributed at 60 cycles, as considerable lighting is also done. The voltage on the transmission line is 25,000. Full particulars are given of the transmission line.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Philadelphia.—The Union Traction Company, of Philadelphia, has seven power stations, two of which are non-condensing and two use mechanical draft. A table shows the kilowatt output of these stations during 1900. The total is a little over 81,000,000 kilowatt hours. Another table shows the total number of men employed in the power stations. In addition to its power stations, the company has five storage battery stations connected to the main stations. Most of the stations are fitted with two positive bus-bars, one being at 550 volts and the other at about 675 volts. The switches of the outlying feeders can be connected to either the high or low-voltage bus-bars, as occasion requires. All the new cars of the company are now of the double truck type, with bodies 28 ft. long and all equipped with air brakes. The company has also installed some new track joints, which are shown.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Some Novelties on the New Haven Railway.—Some engravings show a tower car for construction purposes, in which the principal novel features is the fact that the tower is raised and lowered by hydraulic means. The hydraulic ram is located inside the car, and by it one man can easily raise the tower, even if there are three workmen on it. This allows the position of the tower to be changed while the men are working. Access to the roof is provided through a stairway in the car, and when the tower is down, the roof is no higher than that of an ordinary car, and the roof is also water tight. The maximum height to which platforms can be raised is 18 ft. The article also describes the method of testing motors, in which one motor is run as a generator and the other as a motor. The usual method is to mount the two motors in line and connect the pinions by a sleeve. Instead of this, the motors are mounted with the shafts parallel to each other 4 ft. apart, and are connected by a 5-inch wide belt running over pulleys 18 inches in diameter. The final engraving shows the method of dismounting motors. The bottom of the pit is provided with two tracks, one 18-inch gauge, the other 29-inch gauge. On the latter is an iron framed carriage, and on the former is a small hydraulic jack. To dismount the armature the carriage is run under the motor and the jack underneath the carriage. The lower field of the motor is then lowered by the jack and put at rest on the carriage, which is then slid out of the way and the jack is again run under the car to lower the armature.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Repair Shops.—A description of those of the Rhode Island Railway Company. They will contain a full equipment of electrically-driven tools distributed through a series of different departments which have a consecutive relation to each other. The cars are handled in the equipment department by a transfer table, and in the paintshop by a system of curves and switches. It is expected that the shops will be in operation by July 1.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Combined Trolley and Conduit Systems.—CONNETT.—A paper read before Inst. of Mechanical Engineers, of London. The writer first refers to the cities in which conduits are used and mentions Budapest, Berlin, Brussels and Paris as using the side-slot conduit, and Lyons, Nice, Bordeaux, New York and Washington as using the center-slot conduit. The chief trouble with the side slot is the switch, as shown. The slot here has to be made a certain width to accommodate the flange of the wheels, while with the center slot it can be made any width. The wheels also throw water and mud into the conduit and on the plow. The distance from the conductor bar to the bottom of the conduit, should be from 9 to 10 inches to allow room for water and dirt, but for short distances these clearances could be reduced to 4 inches. A shallow conduit used in Paris is shown, in which these clearances are 4 inches, and the total height is 17 inches. The switch is a critical feature of the entire construction. The construction of a switch for the center slot and for the side slot are shown. Where a mixed system is used arrangements must be made for disconnecting the plow from the car or raising it into the car. The writer discusses the relative advantages of these two methods and shows a method by which the slot is widened, so that the plow can be raised into the car. A cut shows the device on the car for this purpose. He then discusses the cost of conduit construction and gives the additional cost for a conduit road as between £4,500 and £5,600 per km. of track. He then gives some detailed figures from actual installations, and also some figures of estimated construction under different conditions.—*St. R'y Jour.*, April 6, and Int. Ed., April.

The New Conduit Proposed for Use in London.—A full description of the conduit which the London County Council has provisionally adopted for use in that city. The new conduit consists of a small yoke placed between the tracks, which rests upon a concrete bed. The traction rails are connected with the yoke by means of tie rods and rest upon a separate bed of concrete. The conductor rails are supported on brackets, which are fastened to insulators. These insulators are of the pedestal type, and are placed in recesses made in the concrete or cement. The yokes are made sufficiently rigid to hold the slot rails a fixed distance apart. An editorial is also published

commenting at length upon the conduit.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Track Construction.—An illustration showing a type of joint used in Portland, Oregon, where electricity had replaced the cable. The cable yokes were 4 ft. 6 inches apart, and the rail was only 3 inches high, and weighed 36 lbs. per motor. As the company did not want to go to the expense of taking up its old cable conduit, and as a large rail could not be used in the yokes, the joint illustrated was designed. The rail supporting the joint is of the same size as the track rail, and is 40 inches long. Between it and the track rail are six cast-iron blocks $\frac{7}{8} \times 2 \times 2\frac{3}{4}$ inches. The rails are held together by forged iron clips held by a ¾-inch bolt. The old fish plates are kept in place, and two of the steel clips are left short to allow for the fish plates. In the case of crossing, an I-beam 10½ inches high is carried under the joint and riveted to the base of the rail.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Automobiles vs. Tramways.—ADAMS.—An article on the possible competition in the future of electric automobiles with the present tramcars. In favor of the former are the low investment, flexibility of operation, and freedom from the street structures of the tramways. He finds that in the comparison of both systems there is an unbalanced advantage of transportation with battery vehicles, namely, a saving of about one-half of the entire first cost, and also of one-half of the annual interest charges of present tramcar systems.—*Cassier's Mag.*, April.

REFERENCES.

Third-Rail System Near Rome.—Engraving showing an insulator and third-rail to be employed for a line 26 km. in length between Rome and Frascati.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Power Station Figures at Trenton.—These figures give the power station expenses total and per car mile of the Trenton Street Railway Company. The station equipment consists of one 800-hp compound condensing, direct-connected unit, and two 400-hp belted engines of this same type. The average cost of coal delivered is $2.60 per ton.—*St. R'y Jour.*, April 6, and Int. Ed., April.

Weak Fields and Grounded Armatures.—BERRY.—An article on weak fields and grounded armatures, with directions showing how to guard against them in railway motors.—*Amer. Elec.*, April.

Notes from Germany.—The writer first gives a digest of the annual report of the Grosse Berliner Strassenbahn for the year 1900; then two tables showing the growth of the electric railway industry from 1891 to Sept. 1, 1900. He then refers to various accidents which have occurred in Vienna from the falling of telegraph and telephone wires on the trolley wire, in which several horses were killed, but no people were injured.—*St. R'y Jour.*, April 6, and Int. Ed., April.

How to Make Non-Paying Roads Pay.—COOPER.—A discussion of the collection of and registration of fares.—*St. R'y Jour.*, April 6, and Int. Ed., April.

MISCELLANEOUS.

Electricity in Agriculture.—A description of two electric plants for agricultural purposes in Austria and Hungary. The one is a 40-hp plant, in which three-phase current at 2000 volts is generated for transmission to different farms for power purposes and lighting. The other is a three-wire direct-current plant, water-power being utilized. In both cases the introduction of the electric service is said to have been a commercial success, as saving in the cost of operation and an increased output were obtained.—*Zeit. f. Elek.*, March 17.

Paris Exposition.—FEUSSNER.—A paper read before the Elektrochemical Society, of Berlin, in which he gives a report on some instruments at the Paris Exposition. He discusses the rheograph of Abraham, which is an instrument for plotting the waveform of an alternating voltage, or of other quick electric phenomena by projected light curves, which may be used for photographs. He discussed at some length the advantages of the O'Keenan meter and gave an account of some tests of it made in the German Reichsanstalt. He also described Weissmann's experiments with incandescent lamps with thick carbon filaments for pressures of 12 and 22 volts. They were connected to the 110-volt circuit by means of transformers.—*Elek. Zeit.*, Feb. 28.

REYVAL.—Long and well illustrated descriptions of machines, exhibited by the Societe Alsacienne de Constructions Mecaniques. A 750-kw and 200-kw direct-current dynamo, a 1340-kilovoltamp. three-phase alternator, and a 500-kw synchronous converter.—*L'Eclairage Elec.*, March 2.

REYVAL.—A well illustrated description of two machines of Schuckert & Co., driven by the same steam engine. One is an 850-kilovoltamp three-phase alternator, the other a 900-kw direct-current dynamo; also an illustrated description of the Vulcain energy meter.—*L'Eclairage Elec.*, March 9.

KORDA.—An illustrated article on three-phase machines of Ganz & Co.—*Elek. Zeit.*, March 14.

New Books.

BOOKS RECEIVED.

A TREATISE ON ELECTROMAGNETIC PHENOMENA. By Commander T. A. Lyons, U. S. N. New York: John Wiley & Sons. 556 pages, 385 figures and plates. Price, $6.

THE PRINCIPLES AND PRACTICE OF LINEAR PERSPECTIVE. By Herman T. C. Kraus, C. E. New York: Norman W. Henley & Co. 53 pages, 11¼ by 15½ inches, and 14 plates of practical examples. Price, $2.50.

SAW-FILING AND MANAGEMENT OF SAWS. By Robert Grimshaw, M. E. New edition, revised and enlarged. New York: Norman W. Henley & Co. 93 pages, 81 illustrations. Price, $1.

RESEAUX ELECTRIQUES. Nouvelle Methode Generale de Controle de l'Isolement et de Recherche des Defauts sur les Reseaux Electriques Pendant la Service. Par Paul Charpentier. Paris: Ch. Beranger. 23 pages, 6 illustrations. Price, 2.50 francs.

A MANUAL OF LABORATORY PHYSICS. By H. M. Tory, M. A., and F. H. Pitcher, M. Sc. New York: John Wiley & Sons. 283 pages, 63 illustrations. Price, $2.

Electricity in a Modern Foundry.

A new building for foundry purposes was recently erected in Brooklyn, near the waterfront by the E. W. Bliss Company, the well-known manufacturers of punching presses and engines. It measures 100 by 200 ft., and is surmounted by a large skylight, which admits plenty of light and air in addition to that admitted through a large number of windows. Along the southern side of the building extends a gallery where the various machine and woodworking tools are located, as well as the pattern storage room. The moulding is done on the main floor and along the south side, in the center of the building are the two blast furnaces. In the southeast corner is the

FIG. 1.—GENERAL VIEW OF FOUNDRY.

blower room, and in the cellar the engine and boiler rooms, as well as the coal bin and the storeroom for many tons of pig iron are located.

The plant affords a striking illustration of the advantages of using electric power in a foundry. Some idea of the extent of the plant may be gathered from the facts that about 150 men are constantly employed, that the plant is worked night and day, and that on an average of 20 tons of castings are turned out daily, the ultimate capacity of the plant being 50 tons.

As will be seen from Fig. 1, the foundry is equipped with two electric cranes, built by the Shaw Electric Crane Company, having a capacity of 30 tons and 10 tons, respectively. Mounted beneath the gallery at the southwest corner of the building, close to the office, is a 40-hp motor, which drives the machinery on the gallery floor and supplies power to the elevators which convey coal and iron to the furnaces. In the blower room, shown in Fig. 2, a 50-hp motor, attached

to the ceiling, is belted to a Root blower, which supplies air for the blast furnaces. The motor was mounted on the ceiling, so as to be able to accommodate another similar outfit in the same room. There is in addition a 25-hp motor direct connected to a Sturtevant blower, which furnishes air for an indirect heating and ventilating system, hot air being supplied in winter and cold air in summer. This air is distributed by means of large galvanized iron pipes run along two sides of the building, which have a number of outlets radiating in different directions at every supporting pillar, as shown in the figure. There is a valve at each outlet, by means of which the amount of air is regulated.

The building is lighted by means of 40 Helios enclosed arc lamps, two being burned in series on a 220-volt circuit, which experience has shown ensures a short arc and in consequence a remarkably white light. There are, besides, 200 incandescent lamps distributed around

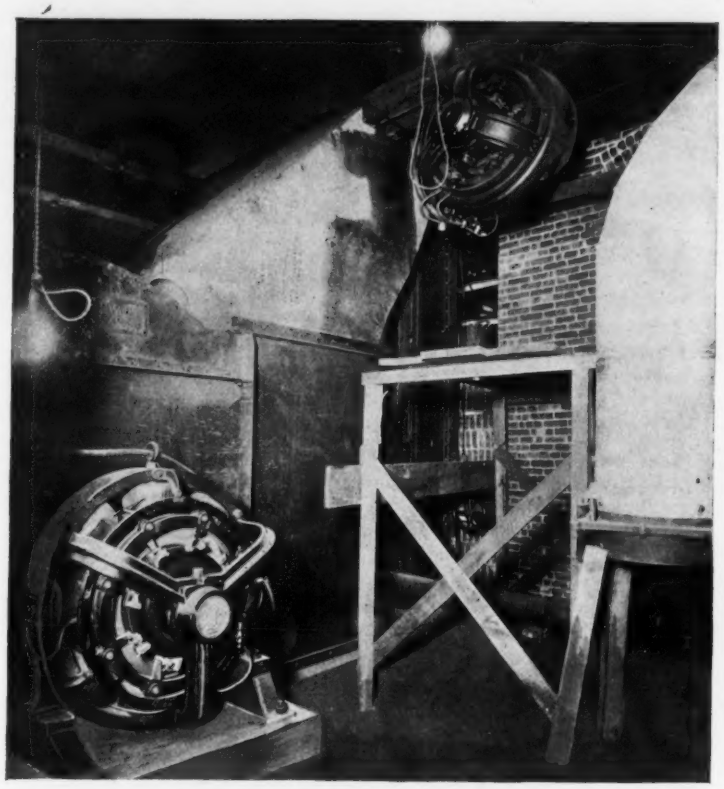


FIG. 2.—BLOWER ROOM.

the gallery, main floor and cellar. In connection with the use of these lamps a very ingenious device has been worked out by the engineer who has designed the entire equipment, Mr. E. R. Knowles, E. E. It consists of a plug outlet of special design attached to each pillar along the sides of the main floor. The workmen require lights while they chip the slugs and burrs from the castings as well as for the inspection of molds. For this purpose the lamps, which are surrounded by wire cages, are attached to long flexible cords having a plug at the other end. These may be inserted into any one of the numerous receptacles and a special wire hook on the latter prevents the workman from pulling the plug out of its socket while working around with the lamp.

The current is distributed from four junction boxes. This minimizes the danger of a complete breakdown of the electrical system by dividing the wiring into a number of sections, each being controlled from an independent junction box. Open wiring has been adopted, all wires being run along porcelain insulators, with the exception of the vertical risers which are all located in conduits. The very best material and workmanship have been employed on this part of the equipment, so as to have it harmonize with the rest of the installation.

In the engine room shown in Fig. 3 are located two direct-connected units, consisting of two Ball & Wood 150-hp engines connected to two 100-kw Sprague 6-pole dynamos, generating 230 volts at 250 r. p. m. To prevent the possibility of a breakdown a duplicate set of units has been installed, and each unit is capable of carrying the maximum load. The mains from these generators are carried beneath the floor to the switchboard, which is situated on a gallery reached by an iron stairway. The board, which was built for the Tucker Electric Construction Company, the contractors, by F. A. La Roche, after the designs of Mr. Knowles, consists of three panels, the center one being the main generator panel and the right and left ones the power and light panels, respectively. On the main panel are mounted two voltmeters and two ammeters of the Wagner switchboard type, with a horizontal pointer, one street service switch, two D. P. D. T. 500-ampere generator switches, two equalizer switches and a ground detector.

On the power panel are five Victor combination switch and circuit breakers and the field rheostats. On the light side are five 75-ampere Victor combination switch and circuit breakers. The average day load is about 300 amperes, and the average night load about 250 amperes. In addition to the machinery enumerated there is a 40-hp Ingersoll-Sergeant air compressor in the engine room, which furnishes compressed air at 80 lbs. pressure for the chipping tools and sand-blast apparatus.

In the boiler room are two vertical Corliss boilers of 150 horsepower each. They are 16 ft. high and 6 ft. in diameter, and each boiler contains 164 2-inch tubes. The boilers are fed by No. 7 Monitor injectors. The auxiliary apparatus consists of an economizer and a $6 \times 4 \times 6$ pump, which furnishes water for foundry purposes.

The equipment clearly shows with what diligence each problem

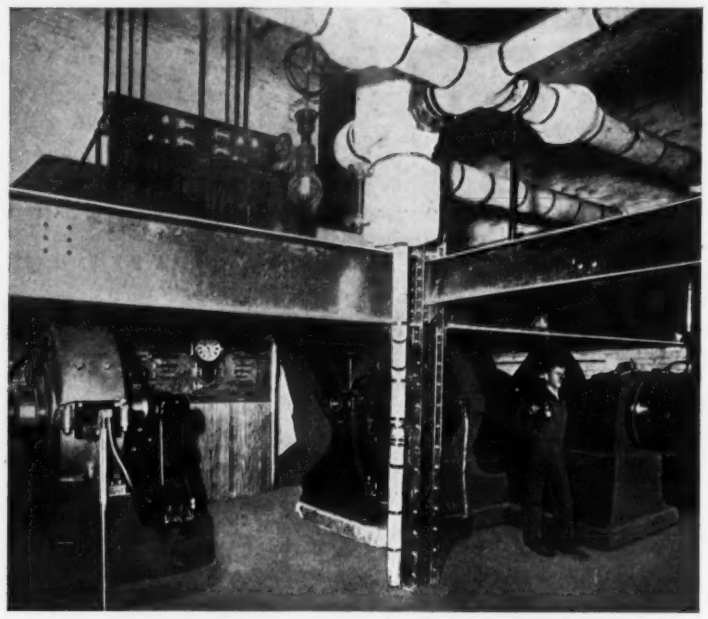


FIG. 3.—ENGINE ROOM.

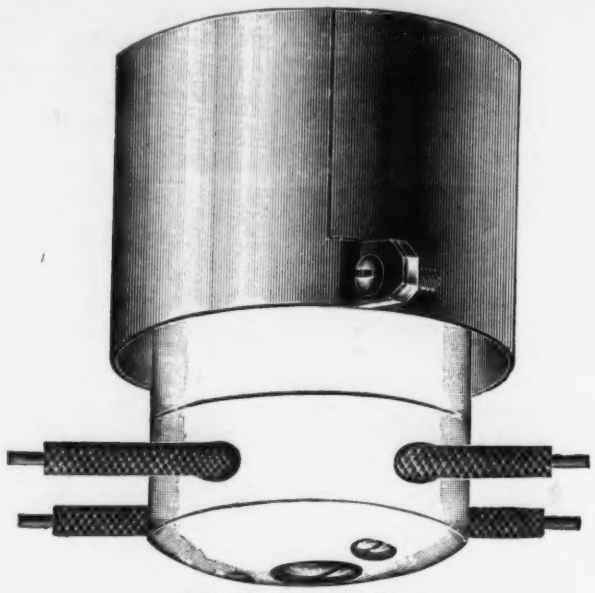
has been studied out and how satisfactorily each difficulty has been overcome, all reflecting great credit on Mr. E. R. Knowles, the consulting engineer for the Bliss Company.

A Bullock and Wagner Selling Arrangement.

The Bullock Electric Manufacturing Company, of Cincinnati, and the Wagner Electric Manufacturing Company, of St. Louis, have effected a combination of their selling organizations. By thus combining forces in the field, they are mutually benefited, inasmuch as the products of the two companies are totally different, and where the product of one is used, the other is likely to be necessary. The product of the Bullock Company consists of a complete line of direct and alternating current machines, from a ½-hp motor to a 10,000-kw generator, controllers of various types and rotary transformers. The Bullock "Teaser" power system for driving large daily newspaper presses has become world famous, and is to-day installed in the press rooms of many leading dailies in Europe and America. The product of the Wagner Electric Manufacturing Company covers a full line of static transformers of all types and of the largest sizes; ammeters, voltmeters, indicating wattmeters, switches, switchboards for all purposes and single-phase self-starting alternating-current motors. The entire absence of complicated starting mechanism especially adapts the Wagner single-phase motor to pumping plants and machinery of like character. Thus it will be seen that the two lines are admirably adapted to be sold by one organization, which will be under the management of Mr. E. H. Abadie, formerly sales manager of the Wagner Company.

Improved Sign Receptacles.

The device shown in the accompanying illustration, with its appliances, is designed to enable the quick making up of electric illuminated signs or decorations for the interior or front of buildings. The receptacles are linked together by S-shaped clamp hooks, which bind firmly about the receptacle, thus clamping the whole structure into a



RECEPTACLE FOR SIGN LAMPS.

rigid outline of any design or proportion desired. For indoor use the receptacles may be readily wired, using the contacts projecting at the back of the main receptacle. For outdoor use, in an exposed position, where weatherproof construction is desirable, the wires are run through openings in the contact cap provided for that purpose. After replacing the contact cap of the receptacle proper, the interior space may be filled with weatherproof compound, a thoroughly weather tight and safe construction being thus obtained. Owing to the fact that the contact caps are spaced at regular intervals, the same contact caps and the same wiring may be readily used in connection with designs entirely different from the one for which they were originally made up, it not being necessary to change the wiring, except in rare instances. A metal rainguard is provided for additional protection to the lamp and socket when they are in use in exposed positions.

These devices, which are known as the Brewster universal sign receptacles and appliances, are manufactured by the Electric Motor & Equipment Company, 12 Beaver Street, Newark, N. J. They are recommended for the use of theaters, merchants and electric lighting companies, as a ready means of changing electric signs. They may also be used for electrical decorations, such as shields, stars, flags, festoons, etc., the same material being used in each instance.

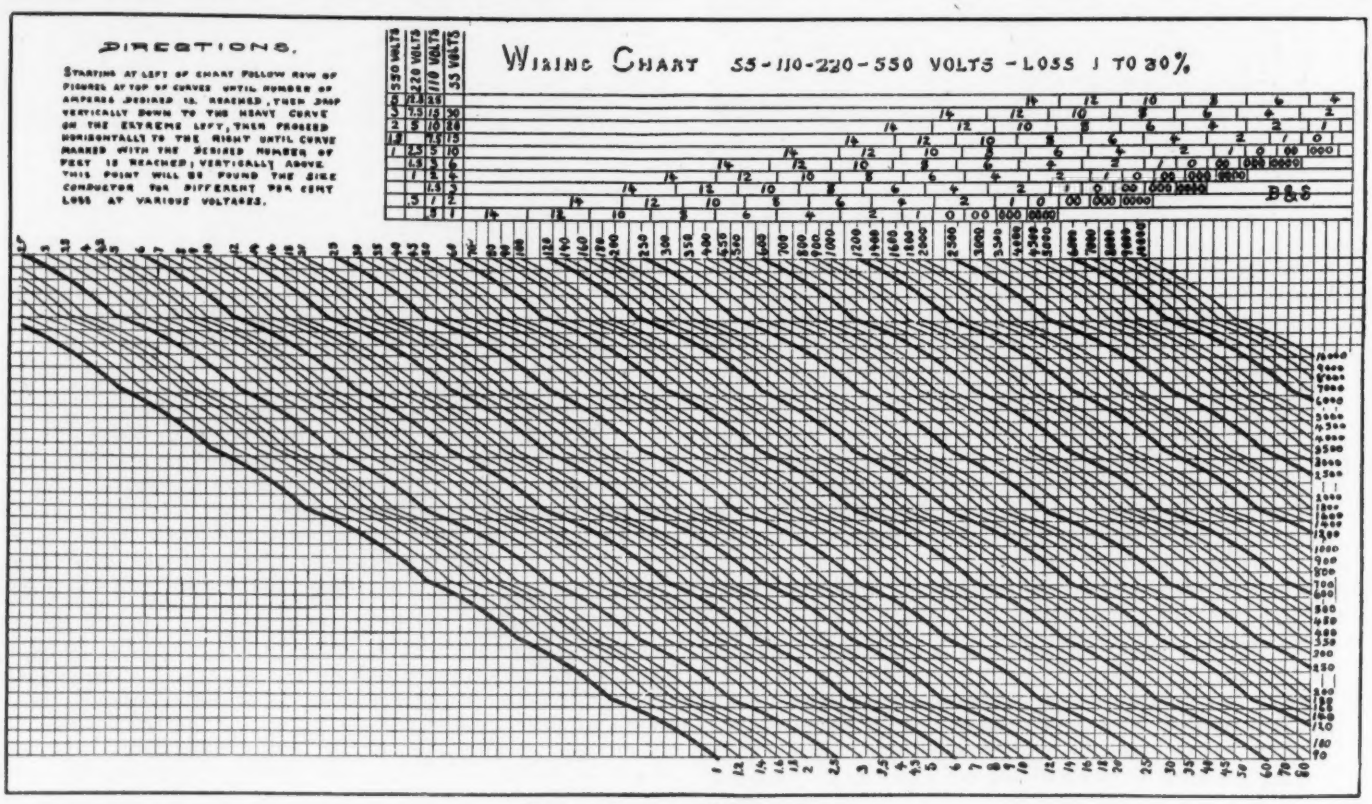
Diagonal Electrical Plier.

It has been noted by the Smith & Hemenway Company, 296 Broadway, New York City, that there has been a long-felt want in the trade for a first-class, tough, non-brittle, diagonal plier for electrical and telephonic purposes, and we now illustrate this company's Swedish diagonal plier, just brought out. The points of merit in this plier are that the jaws are parallel and will cut the finest insulation. At the same time, they are stiff enough to cut any kind of hardened copper wire or light steel or iron wire.

DIAGONAL PLIERS.

Wire Chart.

The accompanying chart, copyrighted by Geo. Ams Tower, of Richmond, Va., was prepared to provide a quick and convenient method of ascertaining the proper size conductor for any direct-current lighting or power circuit. The chart embraces a wide range of conditions, and should prove of value to those having use for a ready means of making such calculations.



DIRECT-CURRENT WIRING CHART.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed at 4½ per cent. nominally. Time money was freely offered during the week and the demand was fair. The rates were 4 per cent. for 30 to 60 days, 3½ for three, four, five and six months. There was little activity in mercantile paper, with a fair but limited demand. The rates are 3¾ a 4¼ per cent. for 60 to 90 days' endorsement, 4 a 4½ for choice four to six months single names and 5 a 6 for others. In the stock market there was considerable irregularity in price movements. Higher money rates—call loans rising to 6 per cent.—caused heavy realizing and renewed short selling. The market continues, however, to be very active and possesses the same strong undertone which has been a leading feature for some weeks past. In the electrical list General Electric exhibited great strength on the highly favorable character of its annual report and the intimations that a stock dividend would be declared to return to the shareholders the 40 per cent reduction of capital made some years ago. No fewer than 32,380 shares changed hands during the week, the highest price reached being 234 and the lowest 213, the closing quotation being 226½, a net gain of 10¼ points. The net gain in the price of this stock since Feb. 9 is 40 points. Western Union was quiet, closing with a net loss of ½ point. The street railway stocks continue in good demand and there was considerable activity in both Metropolitan and Brooklyn Rapid Transit. The sales of the former were 114,590 shares, the net gain for the week's business being 1½ points, and the sales of the latter were 100,070, the net gain being ¾ of a point. American Telegraph & Cable continued on the upward movement and closed with a net gain of 1 point. In the outside market a hopeful tone existed at the close. The net changes in quotations, however, as a rule were confined to fractions, being in a majority of instances advances. The gains, however, were not sufficiently great to overcome the losses suffered in the trading of the earlier part of the week; at the close the most of the active securities were below the firmer figures of the preceding week. American Bridge stocks were in good demand and closed at 49¾ for the common and 103¾ for the preferred. The transportation stocks were quiet, New York Transportation advancing 1½ points; General Carriage closed at 2. Following are the closing stock quotations at the four principal financial centres:

NEW YORK.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
General Electric	216¼	226½	Electric Vehicle	10	12
Brooklyn Rapid Transit	82¾	83½	Electric Vehicle, pfd	20	20
Metropolitan Street Ry	167	168½	General Car	—	2
American Tel. & Cable	99	100	Illinois Elec. Veh. Tran.	1⅛	⅞
Western Union Tel.	93	92½	Hudson River Tel.	120	120
American Dist. Tel.	36	36*	N. E. Elec. Veh. Tran.	—	2½
Commercial Cable	175½	170	N. Y. Elec. Veh. Tran.	4	5½
Electric Boat	20	21	Tel. & Tel. Co. of Am.	6	5
Electric Boat, pfd	50	50	N. Y. & N. J. Tel.	170	160
Electric Lead Reduc'n	4¼	4½			

BOSTON.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
New England Telephone	141	—	Erie Telephone	50	61½
Mexican Telephone	3⅛	3	General Electric, pfd	—	—
Westinghouse Electric	62*	—	Am. Tel & Tel.	170	171
Westinghouse Elec., pfd	—	—	Boston Electric Light	250*	—

PHILADELPHIA.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
Electric Storage Battery	69	75	Philadelphia Electric	6¼	6⅜
Elec. Storage Bat., pfd	70	75	Pa. Electric Vehicle	¾	1
Elec. Co. of America	8½	8¾	Pa. Elec. Veh. pfd	*¾	¾
General Electric Auto	—	—	Am. Railways	41	40

CHICAGO.

	Apr. 6.	Apr. 13.		Apr. 6.	Apr. 13.
Chicago Edison	154	155	Chicago Telep. Co.	220	230
Chicago City Ry	260	257	Union Traction	16	15
National Carbon	15¾	15¾	Union Traction, pfd	56	57
National Carbon, pfd	83	83	Northwest Elev. Com.	40½	40

*Asked.

ELECTRIC VEHICLE BONDS.—Official announcement was made last week of the issue of $1,675,000 of short term bonds by the Electric Vehicle Company. The conditions under which the bonds are to be issued and the purpose of the loan are explained in the following circular received by the stockholders: You are hereby notified that the Electric Vehicle Company, under action of its Board of Directors, has authorized the issue of $1,675,000 of bonds of the denomination of $1,000 each, bearing 6 per cent interest from May 1, 1901, payable on November 1 and May 1 in each year. These bonds mature on April 30, 1904, unless sooner retired by the sinking fund, or drawn for redemption and cancellation under the provisions of the Trust Deed, at par and accrued interest, at any time prior to maturity. These bonds have been underwritten at 90, as of May 1, 1901, by a syndicate who agree to take all which are not subscribed for by the shareholders of record at the close of business, April 22, 1901. Under the resolution of the Board and the terms of the agreement with the underwriting syndicate, these bonds are now offered to the shareholders of the Electric Vehicle Company upon exactly the same terms as they have been underwritten, namely, at a price of 90, as of May 1, 1901. You are entitled to subscribe at the price of 90 to a par value of these bonds equal to 9 per cent of the par value of the stock (both preferred and common), standing in your name upon the books of the company at the close of business, April 22, 1901. To cover cases where a subscription is for an amount less than $1,000, or greater than $1,000, without being a multiple thereof, it has been arranged for the issuance of scrip which can be exchanged into bonds when offered in amounts of $1,000 or multiples thereof. The sum to be realized from these bonds, namely, $1,507,500, will more than pay off all existing debt of the Electric Vehicle Company, and the surplus will be paid into the treasury to be used as working capital.

STATUS OF ERIE TELEPHONE.—Stone & Webster's report of the physical examination of the Erie Telephone properties covers a thorough examination of the entire system which has in operation nearly 300,000 miles of wire. Several experts have been engaged upon the work since December 1. The report is a large bound volume containing photographs of 60 exchange buildings owned by the subsidiary companies, with estimates of valuation of the various properties. Fully 90 per cent of the Erie's 95,000 miles of long distance wire system is constructed on or adjacent to railroad property giving the system clear and unobstructed right of way for its long distance wires, while far in excess of a majority of its subscribers lines in the large exchanges are underground. The report shows a large excess capacity of pole, cable, underground conduit and switchboards arranged for the rapidly increasing business and the classes of construction established during the past three years which has required an expenditure upon the plant in excess of $16,000,000. On the whole the report is favorable to the value and stability of the property.

GENERAL ELECTRIC CAPITAL.—It is stated that the General Electric Company is about ready to return the capital reduction made in 1898. It is understood that this will be done in the form of a 66 2-3 per cent dividend of stock, each holder of three shares getting two shares as a dividend. On the increased capital it is expected that 8 per cent dividends will be maintained as a minimum, and it is possible that dividends may be increased to a 10 per cent basis. At 230 three shares of General Electric would cost $690. This would then represent five shares of an 8 or possibly 10 per cent stock, worth say 160 as an 8 per cent stock or 200 as a 10 per cent stock in view of the company's ability to earn 20 per cent on the increased capital. Five shares at 160 would be worth $800 or $110 more than the present cost while at 200 they would be worth $310 more. In the one case this would mean a price of 266 for the present General Electric stock, and in the other it would represent 333. The stock is selling around 230.

RAILWAY $1,000,000 MORTGAGE.—The Delaware General Electric Railway Company has filed with the Recorder of Deeds for Kent county a mortgage for $1,000,000 given to the Knickerbocker Trust Company of New York City, for the construction of the Kent county trolley, work on which has been begun this week.

NEW YORK LIGHTING CONSOLIDATIONS.—There are indications that the lighting interests of Greater New York are drawing closer together, and it is rumored that the combined capitalization, gas and electric, may be put at just short of $300,000,000. Meanwhile all these securities are strong and rising.

DIVIDENDS.—The International Steam Pump Company has declared regular quarterly dividend 1½ per cent on preferred stock, payable May 1. H. R. Worthington, Inc., has declared a dividend of 3½ per cent. on the preferred stock, payable May 1.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports to the mercantile agencies as to trade conditions were generally favorable and indicate continued improvement. The seat of greatest strength is in the iron and steel trade. Finished products are active, and most mills are sold ahead beyond July. Despite the drop in export trade, some orders are being received. The gross railway earnings by 100 systems for March aggregate $56,495,887, a gain of 7.4 per cent over

1900, and following a gain a year ago over 1899 in the same month of 12.5 per cent. The Granger roads alone show decreases. For the first three months of the year, earnings of 100 roads show a gain over the same period of last year of 6.7 per cent, following a gain of 16.2 per cent in 1900 over 1899. The failures for the week, as reported by *Bradstreet's*, numbered 225, against 188 the week previous and 152 the corresponding week last year. In the copper market, the developments of the week have strengthened the position of the producers, who are in control of the situation, and although there has been no change in quotations, the tone of the market is somewhat stronger. The quotations generally given in the trade are: Lake Superior ingot, 17 cents, and electrolytic 16⅝ cents. The exports of copper so far this month have amounted to 1,199 tons and the imports 1,164 tons.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, through its secretary, Mr. James Wilson Bullock, has acquired control of fifteen acres of land directly opposite the present plant at East Norwood, Ohio. Upon this tract the Norwood Foundry Company will erect a foundry building 200 feet long by 150 feet in width; a pattern storage house, fireproof construction, 50x150 feet, three stories high; and a modern office structure. All these buildings will be built of buff pressed brick with steel frames and trusses to conform to the present buildings of the Bullock Electric Manufacturing Company. The foundry will be equipped with three electric cranes, the largest of which will have a capacity of fifty tons. The side bays, which will be 25 feet in width, will be served by hand traveling and jib cranes. The plant will be of the most modern character, and electricity will be used for power and lighting throughout. While this foundry will be operated under the name of the Norwood Foundry Company, it will serve primarily the needs of the Bullock Electric Manufacturing Company. It will also be in position to handle outside orders in a satisfactory manner. That it will be operated successfully is guaranteed by the fact that it will be under the direction of Messrs. Hoffinghoff & Lane, of Cincinnati, a firm whose skill in handling foundry work is well known.

STEAM ENGINE CONSOLIDATION.—It was stated last week that the activity and strength of the stock of the International Power Company is, in anticipation of a combination of stationary steam engine companies, with a possible capitalization of $50,000,000. It is said that the combination or merger will be made through the International Power Company. This company's ownership of all the Green-Wheelock and Corliss patents, with these several large plants, it is asserted probably makes it the largest stationary engine manufacturing company in the world, but the Allis interests at Milwaukee are doubtless much larger. The International Power Company, which has three plants in Worcester, Mass., and Providence, R. I., has purchased a large tract of land at Paterson, N. J., on which it will immediately begin to erect a big plant where it will concentrate all its works. It expects to employ 2,500 workmen within a year. The company was attracted to Paterson during the negotiations for the sale of the Rogers Locomotive Works. It manufactures locomotives, stationary engines and auto-trucks

BRITISH TELEPHONE CONTRACT.—The Western Electric Company has received a large contract for telephone apparatus from the British Government, and there have been charges that British firms did not have a fair chance to compete. The London manager is reported by cable to have said: "Our contract does not reach anything like £1,000,000. The cables we are installing were made by British labor at our works in Woolwich. Only materials which are absolutely unsecurable here are being imported from America. The British Post Office authorities and all persons connected with telephonic construction in Great Britain and on the Continent admit that these are far ahead of any made on this side. The greater part of the appropriation of £2,000,000 will be spent in breaking up roads and similar work. The British firms had a fair show, and it was only when it was found that they were unable to provide the materials that the Post Office here dealt with an American firm."

STURTEVANT FIRE.—We record with regret the following special dispatch from Boston of April 14: The main building of the extensive blower works of the B. F. Sturtevant Company, in the Jamaica Plain district, was burned early this morning, causing a loss of $350,000; fully insured. The concern manufactured various kinds of machinery and electrical goods as well as blowers. The company recently had added $75,000 worth of tools and machinery, and had a large amount of electrical work ready for shipment. It also had a large number of engines and blowers for the Government for use on battleships and cruisers, in course of construction, all of which were destroyed. Superintendent Chamberlain states that the business will be carried on without much delay.

THE C. & C. ELECTRIC COMPANY, of this city, reports the receipt of contracts from C. R. Heap, of 47 Victoria Street, London S. W., calling for nine motors averaging 15-hp each. John Wanamaker, of Philadelphia, has ordered four 75-kw and one 50-kw generators; also five motors, two of 18-hp each, the same number of 12-hp each and one of 6-hp. These machines are intended to be installed for lighting and general power purposes in new buildings being constructed by the Pennsylvania merchant. The Defender Manufacturing Company, of New York City, has ordered twenty-nine C. & C. motors, which vary from 5 to 6-hp each, to drive sewing machines, laundry equipment and blowers. They will be direct-connected to the shafts.

EQUIPPING RAILROAD SHOPS.—The new large machine shops being erected at Elizabethport, N. J., for the Central Railroad of New Jersey, for which Mr. George Hill is consulting engineer, will be equipped exclusively with Lundell power apparatus manufactured by the Sprague Electric Company. The equipment will consist of three 100-kw generators of 240 volts and 250 r..p. m., direct-connected to Ball & Wood engines, and 75 motors of various sizes for driving the machine tools. All of the motors and one generator are booked for delivery in June and the other two generators will be delivered in July. This is probably the most important contract of the kind ever awarded in the railroad field.

FOREIGN TRADE FIGURES.—The monthly statement of the imports and exports of the United States, issued by the Treasury Bureau of Statistics, shows that during the month of March, 1901, the imports of merchandise amounted to $75,949,088, of which $36,706,366 was free of duty. The total is a decrease from March, 1900, of $7,200,000. The exports of domestic merchandise amounted to $122,300,579, a decrease of $9,450,000, attributable apparently to lower prices. The gold imports amounted to $2,487,019, an increase of $500,000. The gold exports amounted to $490,269, a decrease of $600,000. Silver imports amounted to $2,731,733, a decrease of $400,000. Silver exports were $5,150,186, a decrease of $300,000.

THE VEZIN MACHINE COMPANY, of New York, has secured an order through the American electrical engineering and contracting firm of Bagnall & Hilles, Yokohama, for the shipment of two high-speed engines developing 1350 and 1100 revolutions per minute respectively. One of these engines will be direct-connected to a Sprague Electric dynamo. The Vezin machines will be utilized for electric light purposes in Japan. The Jones & Moore Electric Company, of Toronto, has ordered one 10-hp engine of 1000 revolutions per minute, and two 6-hp machines of 1250 revolutions. Recently closed domestic orders include a small engine sold to the General Electric Company having a capacity of 2400 revolutions a minute.

THE ST. LOUIS CAR COMPANY, of St. Louis, Mo., has just closed a number of domestic contracts through its recently appointed New York representatives, Edward D. Floyd & Company, whose offices are in the Taylor Building, 39-41 Cortlandt Street. The Oneonta Cooperstown & Richfield Springs Railway Company has requisitioned for nine 50-foot high-speed cars; the Schenectady Street Railway Company has ordered six 45-feet cars, while the Hamburg Railway Company, of Buffalo, N. Y., is to be furnished with four cars having a length of 38 feet each. These orders aggregate nearly $75,000 in value.

NEW MANUFACTURING PLANT.—It is stated that H. M. Shaw & Company, 115 Broadway, New York, will erect a plant at Ampere, N. J., for the manufacture of their specialties, including trolley devices. The firm at the present time is having its goods manufactured at different places and the object of building a plant of its own is to enable the firm to manufacture all the different devices in one plant. The contract for the equipment has not yet been given out.

ECONOMIZERS.—The Boston Elevated Railway Company has ordered two more Green economizers for its Lincoln Wharf power station and also another one to be installed in Charlestown Station, which will then double the present economizer capacity there. The contract was placed with the Green Fuel Economizer Company, the sole maker in the United States, through its Boston office, at 53 State Street.

BALL ENGINE CONTRACTS.—Among recent installations by the Ball Engine Company, Erie, Pa., of engines for electrical purposes are the following: American Circular Loom Company, Aldine, N. J., one 100-hp direct-connected engine; Maryland Telephone Building, Baltimore, Md., one 80-hp and one 60-hp direct-connected engine.

A FLOATING EXPOSITION is proposed to be organized at Buffalo during the summer and to visit the chief cities of the Gulf of Mexico and the Caribbean Sea. The success of a similar French scheme is cited. Those who remember the story of the "White Special" organized a few years ago to travel over the railroads in this country do not appear to be oversanguine as to results.

THE CINCINNATI PLANER COMPANY, of Cincinnati, Ohio, is pushing its new building to completion, and expects to have it ready for occupancy by June 1. This is an addition to the company's present plant and will give a total floor area of about 25,000 square feet. The buildings are one story brick fitted with travelling cranes, and are well adapted to the building of heavy machine tools.

THE LAMBERT HOISTING ENGINE COMPANY, Newark, N. J., has installed a three-motor, electric travelling crane, manufactured by the Northern Engineering Works, of Detroit, Mich.

General News.

THE TELEPHONE.

CLARENDON, TEX.—The Clarendon Telephone Company has been incorporated with a capital stock of $3,000.

HUDSON, OHIO.—The Central Union Telephone Company (Bell) has completed a new toll line from this place to Twinsburg.

CARTERSVILLE, GA.—The Southern Bell Telephone Company has applied for a franchise to put in an exchange in Cartersville.

WOODBURY, PA.—The Eastern Telephone & Telegraph Company has been granted a franchise to operate its business in Woodbury.

NORWALK, OHIO.—Messrs. Frank H. Knapp and C. R. Callaghan, of Bellevue, have purchased the Huron County Telephone Company.

HOLLY SPRINGS, MISS.—After a long fight the Cumberland Telephone Company obtained permission from the board of aldermen to operate an exchange here.

LOHRVILLE, IOWA.—At the recent municipal election the proposition to grant franchises to the Central Telephone Company and the E. H. Martin Telephone Company carried.

BOSTON, MASS.—The Erie Telephone system made a net gain of 2221 subscribers in March; net gain since January, 3020; total connected March 31, 144,619; waiting connection 3490.

CAMDEN, TENN.—The Camden Telephone Exchange has been incorporated. Capital stock, $1,000. Incorporators: W. L. Morris, T. J. Lowery, W. P. McGill, U. A. Potts and D. G. Hudson.

CHESTER, PA.—The stockholders of the Delaware County Telephone & Telegraph Company have sold the property and franchise of the company to the United Telephone & Telegraph Company.

SAN ANTONIO, TEX.—The San Antonio Telephone Company has 650 instruments in operation, and as soon as the new cable arrives connection will be made with nearly 1,000 additional instruments.

CHICAGO, ILL.—The Advance Electric & Telephone Company, Chicago, has been incorporated. Capital stock, $15,000. Incorporators: V. Horace Messenger, H. Henry Hansen, and George A. Thompson.

TRENTON, N. J.—The American Home Telephone Company has been incorporated; capital, $2,000,000. Incorporators: Alfred G. Brown, of East Orange, N. J.; Edward B. Hawkins, Edward T. Magoffin.

BALTIMORE, MD.—The Chesapeake & Potomac Telephone Company has put into service in its main exchange a $125,000 new relay common battery switchboard, said to be the largest of the kind in the world.

SULLIVAN, MINN.—The Sullivan Telephone Exchange has been incorporated to operate a local exchange. Incorporators: John R. Pogue, A. O. Harrison, Sarah H. Kirk, John L. Kirk and James L. Kirk.

SAN FRANCISCO, CALIF.—The Pacific States Telephone & Telegraph Company has been buying large numbers of poles in Idaho, and it is said that the company will build 300 miles of telephone lines in the Clearwater region this year.

LANCASTER, PA.—A mortgage given by the United Telephone & Telegraph Company, of Philadelphia, to the Equitable Trust Company, of Philadelphia, has been entered in the Recorder's office. It is for $2,000,000 and is payable January 1, 1931.

ALBANY, N. Y.—The Central New York Telephone & Telegraph Company, of Utica, has filed with the Secretary of State a certificate of increase of its capital stock from $800,000 to $1,000,000. The company has a paid-in capital of $800,000, and debts and liabilities of $210,961.

ALEXANDRIA, IND.—The Alexandria & Elwood Central Union exchanges have been consolidated and Ira M. Stabler, the former manager of the Alexandria exchange, will be transferred to Terre Haute. It is not improbable that many other exchanges will be consolidated where feasible.

ASHLAND, KY.—The Citizens' Telephone Exchange was completely destroyed by fire on April 5 and the entire service for this city and the district from Parkersburg, W. Va., to Greenup, Ky., and Cleveland, O., to Rush, Ky., was paralyzed. The fire was caused by a crossed electric light wire.

RICHARDSON, TEX.—The homes of farmers in this section will soon be connected by telephone. A company which proposes to run lines from here to Alpha and to Audelia was organized with a capital of $750. C. H. Blewett was elected president, Sam Harben secretary, and William Guion treasurer.

ATLANTA, GA.—The directors of the Standard Telephone Company elected F. V. Turner secretary. While no definite plans are announced, the directors say they will make every possible improvement in the system, and that connection with a large number of Georgia towns will be made as soon as possible.

SAN FRANCISCO, CALIF.—During the first quarter this year the net gain of the Pacific States Telephone Company central stations was 7,766 subscribers, total 93,510, equal to over 36 per cent per annum. The city of San Francisco showed a net gain of 2,678, total 24,002, equal to over 50 per cent. per annum.

PORTLAND, ORE.—The Columbia Telephone Company, of Portland, has extended its lines to Sellwood, Oregon, and to Mt. Scott. An extension to Forest Grove is projected. There is also talk of building a long-distance line to connect Portland with the lines of the new independent telephone company in Seattle, Wash.

CARLYLE, ILL.—Col. J. H. Allen, of St. Louis, has been granted permission by the Bond County supervisors to construct a telephone line in that county. He intends to connect by telephone the towns of Greenville, Smithboro, Woburn, Mulberry Grove, Pleasant Mound, Hookdale, Tamalco, Keysport, Beaver Creek, Dudleyville and other places.

PITTSBURG, PA.—Director J. O. Brown, of the Department of Public Safety, has awarded contracts for telephones in police patrol booths to the Central District & Printing Telegraph Company at $3 each a year, and for office telephones to the Pittsburg & Allegheny Telephone Company at $48 each a year. There are 210 telephones in patrol boxes.

FT. WAYNE, IND.—The Fort Wayne Home Telephone Company held its annual meeting last week and declared a dividend of 6 per cent. This is an independent company, and the owners are Fort Wayne business men exclusively. The company recently purchased the long distance lines controlled by the independent companies in this vicinity, and is preparing to extend the long distance service.

WABASH, IND.—At a meeting of the National Telephone & Telegraph Company held here recently the capital stock of the company was reduced from $1,000,000 to $250,000. The company owns a large system of telephone toll lines, covering the section of the State surroundings Wabash. Heavy taxation of the capital was the motive for the reduction. Four Western men will take the place on the board of directors recently occupied by New Yorkers.

CLEVELAND, O.—Extensive improvements and extensions are in contemplation for the operating telephone companies, of which the Federal Telephone Company is the parent financing corporation. Bonds for $3,000,000 of the Cuyahoga Telephone Company, the local operating company, are to be sold and the money used for the completion of the plant in Cleveland and for extensions of the long-distance lines throughout the State. New exchanges and systems will be placed in Ohio towns.

BRITT, IOWA.—The Iowa, Dakota & Minnesota Telephone Company was organized about six months ago with a capital stock of $100,000. The general office is at Sioux Falls, S. D., and there is a branch office at Britt, Iowa. The officers of the company are as follows: Thos. A. Way, president; Stitzel X. Way, vice-president; T. A. Potter, general manager; B. C. Way, secretary, and E. P. Healy, treasurer. This company owns and operates telephone lines in Iowa, Minnesota and South Dakota.

WABASH, IND.—The Central Union Telephone Company is making a secret but determined effort to gain control of the Home Telephone Company, of this city, offering liberal premiums for stock. The franchise of the Central expires next year. The Grocers' and Butchers' Association attempted to boycott the Central by ordering the telephones all taken out, but the customers remonstrated until a few declined to abide by the agreement, and now all are coming back in order to hold their trade.

ROCHESTER, IND.—The Rochester Telephone Company has purchased the telephone line along the Standard Oil Company's pipe line from Roann to San Pierre, a distance of seventy-five miles. The company will at once rebuild the line and open stations at all intermediate points between the two cities. At Roann connection will be had with the independent long-distance telephone service of Indiana, Ohio, Illinois and other States. It will also connect with the local telephone systems of a dozen or more of the cities in Northern Indiana.

LANCASTER, PA.—The Independent Telephone Company, of Lancaster County, has been absorbed by the United Telephone & Telegraph Company of Pennsylvania. The officers of the local company resigned and in their stead the following were elected: President, Edward Davis, Philadelphia; Secretary and Treasurer, F. E. Smith, Philadelphia; Directors, W. D. Barnard and E. M. Yarnell, Philadelphia; R. G. Park, Merion; F. G. Hobson, Norristown; Hon. Ward R. Bliss, Chester; G. R. Van Alen, Northumberland; C. M. Clement, Sunbury; S. P. and H. P. Light, Lebanon; A. J. Harner and W. H. Hartman, Lancaster. The purchasers are now in possession of the local companies in a dozen counties in eastern Pennsylvania and are gradually extending their system in the East to New York.

OTTAWA, ONT.—A bill has been introduced into the Dominion Parliament by a private member, that is designed to make the Bell Telephone Company live up to the provisions of its act of 1892. The new bill renders it obligatory upon the company, where it has already constructed or may hereafter construct a main or branch telephone service or system, to furnish all persons requiring telephones whose premises front upon or are adjacent to such service. The bill also provides that no higher rates than the rates now in force in the municipalities of Canada respectively, shall be chargeable in any such community; and any sum paid in excess of the said rates may be recovered at law or deducted from any rates unpaid. This act is retrospective in its operation, and will, if passed, compel the Bell Telephone Company to refund those of its subscribers who have been forced to pay higher rates than contemplated by the act of 1892.

PITTSBURG, PA.—The Federal Telephone Company, whose office is in this city, has recently absorbed the following telephone companies located in Western Pennsylvania: Elizabeth Telephone Company, Elizabeth, Pa.; Carnegie Telephone Company, Carnegie, Pa.; Latrobe Telephone Exchange Company, Latrobe, Pa.; McKeesport Telephone Company, McKeesport, Pa.; Washington County Telephone Company, Washington, Pa.; Washington Telephone Company, Washington, Pa.; Kiskiminetas Valley Telephone Company, Apollo, Pa.; Pennsylvania Telegraph & Telephone Company, Beaver Falls, Pa.; Ewing Telephone Company, Avonmore, Pa.; Home Telephone Company, Cecil, Pa.; Home Mutual Telephone Company, Canonsburg, Pa.; Home Mutual Telephone Company, Houstonville, Pa.; Local Telephone Company, Leechburg, Pa.; Home Mutual Telephone Company, McDonald, Pa.; Home Mutual Telephone Company, Venice, Pa.; Mutual Home Telephone Company, Washington, Pa.; Youngstown Telephone Company, Youngstown, Pa.; Coraopolis Telephone Company, Coraopolis, Pa.; Sewickley Telephone Company, Sewickley, Pa. In addition thereto, the Federal Telephone Company has built or owns or controls the telephone properties in fifty-four cities and incorporated boroughs in Pennsylvania and has completed its lines in and through sixteen villages.

ELECTRIC LIGHT AND POWER.

PHILADELPHIA, PA.—The Ambler Electric Light Company, Ambler, Pa., has offered its plant to the borough for $25,000.

GREENWOOD, IND.—A special election will be held in this city to pass upon an ordinance providing for a new electric light plant.

PORTSMOUTH, OHIO.—The city council has passed a resolution to spend $30,000 for rebuilding the municipal electric lighting plant.

PORTSMOUTH, OHIO.—The Heer Shoe Company, of Portsmouth, is preparing to install a 100-kw, 220-volt generator, and four or five motors, in a new shop.

DRESDEN, ONT.—A by-law to borrow $10,000 to purchase an electric light plant for the town of Dresden, has been approved of by the ratepayers of the town.

SEATTLE, WASH.—The Seattle Cataract Company recently filed a petition with the board of public works for leave to extend its electric light and power system.

SALISBURY, N. C.—Mr. Edwin I. Frost, acting for himself and New York associates, has purchased the property of the Salisbury Gas & Electric Light Company.

NEW ORLEANS, LA.—The New Orleans Lighting Company, capital $2,000,000, has been incorporated by Henry B. Royson, of New York, C. F. Schumann, M. N. Butler and W. R. H. Hardingham.

NEWARK, N. J.—The Board of Directors of the United Electric Company of New Jersey has decided to accept the ordinance passed by the Board of Works of this city providing for the burial of the company's wires.

ST. LOUIS, MO.—The Imperial Electric Light, Heat & Power Company is confronted with the possibility of a general strike in all of its departments. Union firemen have been discharged and negroes put in their places.

TRENTON, N. J.—The New Orleans Lighting Company has been incorporated in this State. Capital, $2,000,000. Incorporators: Henry B. Payson, Charles F. Gehrmann, Malcolm M. Butler and Walter R. H. Hardingham.

ALBANY, N. Y.—The Au Sable Electric Light & Power Company, of Au Sable Forks, Clinton County, has been incorporated; capital, $25,000. Directors: James Rogers, George Chahoon and J. Monroe Sheffield, Au Sable Forks.

RICHMOND, VA.—The Petersburg Gas Company has been chartered, with capital limited to $200,000 to manufacture and distribute gas and electricity for motive power, etc. F. H. Shelton, Philadelphia, is secretary and treasurer.

SAN FRANCISCO, CALIF.—The American Fuel & Power Company has been incorporated in San Francisco. Directors: H. Sherwood, C. E. Tarrent, M. Sherwood, W. M. Kratz and C. E. Jones. Capital stock, $25,000, fully subscribed.

KINGSTON, ONT.—Mr. Frederick Thompson, of Montreal, has been appointed electrical expert for the city of Kingston, to evaluate the plant in the power-house there, which the city purposes purchasing by arbitration. He will draw $25 per day salary.

VINCENNES, IND.—The city authorities have notified the City Electric Lighting Company and its sureties that the company has failed to comply with its contract; that the service is unsatisfactory and that action would be taken unless the service is improved.

SAN FRANCISCO, CALIF.—It is reported that the Truckee River General Electric Company has taken over the Virginia (Nev.) & Gold Hill Water Company's electric lighting plant and arranged to supply current for lighting the towns from the electric transmission plant in Floriston, Cal.

APPLETON, WIS.—Articles of association have been filed by the Fox River Valley Gas & Electric Company. The company is capitalized at $350,000. David N. Cameron, Thomas A. Rockwell and James H. Jenkins, of Oshkosh, are the incorporators. All the plants of the company are generating power and gas and the general offices will be located at Appleton .

SAN FRANCISCO, CALIF.—It is reported that John Martin, president of the Bay Counties Power Company, has purchased the lighting systems of Marysville, Chico and Woodland, Calif., and is negotiating for those of Petaluma, Santa Rosa and San Rafael. He has taken possession of the electric lighting plants of Grass Valley and Nevada City, Calif., and it is said he will install a gas plant at one of these towns.

SAN FRANCISCO, CALIF.—The Riverside Power Company recently entered into an agreement to supply the town of Riverside, Calif., with electricity at the rate of $6 per horse-power per month. The steam-power municipal electric lighting plant, which was constructed at a cost of $50,000, is unable to supply the demands. The Power Company has arranged to begin work on a water-power electric transmission system at an early date.

OTTAWA, ONT.—A bill to incorporate the Ottawa & Hull Power & Manufacturing Company has passed the Private Bills Committee of the Dominion Commons. This bill incorporates Messrs. W. C. Edwards, J. A. Cameron, J. C. Edwards, R. G. C. Edwards, Hiram Robinson, H. K. Egan, Robert L. Blackburn and Russell Blackburn, with a capital of $1,000,000, to develop electric power, do a lumbering, farming, mining and steamship business and other works.

SYDNEY, N. S.—A syndicate, promoted by Mr. B. F. Pearson, of Halifax, N. S., is buying out the Sydney Gas & Electric Light Company, paying therefor $40,000. The Sydney Ferry Company, the Eastern Telephone Company and the Electric Tramway Company, to which latter company the local legislature of Nova Scotia last year gave an extensive franchise, are included in the deal. An electric tramway will immediately be constructed from Glace Bay to Sydney.

SAN FRANCISCO, CALIF.—The Interstate Power Company has been incorporated, with Dalles City, Oregon, as the principal place of business. Directors: E. Kurtz, W. H. Moody, J. P. McInerny, Max A. Voght, H. L. Kuck, L. E. Crow and Ed. M. Williams. It is proposed to operate an electric power plant on the Des Chutes River and conduct electricity for lighting and other purposes to Dalles City and other places in Wasco County, Oregon, and into Klickitat County, Washington.

COLUMBUS, OHIO.—Bids are being received by the board of public improvements of this city for lighting, for periods ranging from five to ten years. The bid of the Columbus Light Company to furnish enclosed alternating arc lamps for ten years all night lighting at $78 per lamp per year, was the lowest proposition received. A temporary injunction was granted, restraining Director Kauffman from awarding the contract on the ground that a proposition had already been made to the municipal lighting plant.

PITTSBURG, PA.—The new electric light plant of the Pennsylvania Light, Heat & Power Company, located at Preble Avenue and Ontario Street, in lower Allegheny City, will be ready for operation within the next sixty days. The power plant occupies an entire square and is equipped with the latest machinery. The installation consists of two 250-kw Westinghouse generators. The company intends to compete for patronage with the Allegheny County Light Company of Pittsburg. It has already secured over 1000 subscribers, the lines have been put up, and the management expects to furnish current to its customers by June 1.

OTTAWA, ONT.—Ottawa will soon have a third big electric corporation furnishing electricity for heat, light and power. A charter is about to be granted by the city council of Ottawa to the Consumers' Electric Company for such purposes. The new company's rates will be 10 per cent. lower than those of the Metropolitan company. Sixteen candle-power incandescent lights will be supplied at 10 cents per week and arc lights about $55 a year. The city, under its present agreement with the Ottawa Electric Company, pays $65 a lamp per year. There will also be the same reduction in the price of power. The Metropolitan company's figures for power, as set forth in its agreement with the city, are from 1 to 4 horse-power, $50 per annum; 5 to 9, $45; 10 to 19, $43; 20 to 49, $38, etc.

SAN FRANCISCO, CALIF.—City Engineer Grunsky, of San Francisco, under the orders of the Board of Public Works, has been obtaining figures and data on the question of municipal ownership of public utilities. It has been proposed to establish a water system, bringing water from the Sierras by gravity and using the same to generate electricity for lighting and power purposes and to operate a municipal electric street railway line, taking current from an underground conductor. It is a part of the plan to have a distributing station located in the City Hall and to install an underground conduit system to distribute electricity throughout the city. The Geary Street cable line is talked of for a municipal electric road, as the underground conductor could be placed beneath the cable slot at small expense.

APPLETON, WIS.—Articles of association were filed April 1 by the Fox River Valley Gas & Electric Company, whose object is to furnish light, heat, steam, power and hot water to the cities of Neenah, Menasha, Appleton, Kaukauna and Green Bay, also in all towns and villages in various counties. The new company is capitalized at $350,000. David N. Cameron, Thomas A. Rockwell and James H. Jenkins, of Oshkosh, are the incorporators. All the immense plants of the company for generating power and gas and the general offices will be located at Appleton. Big electric power houses will be erected. The energy will be transmitted to sub-stations in the adjacent cities and towns. The company has purchased the Appleton Gas Light & Fuel Company's plant and also the Neenah and Menasha gas and electric plant.

THE ELECTRIC RAILWAY.

CINCINNATI, OHIO.—The Cincinnati, Milford & Hillsboro Railway Company has been incorporated with $100,000 capital stock.

CHARLOTTE, N. C.—Surveyors have begun work on the route of the proposed electric line between Gainesville and Dahlonega, Ga. J. F. Moore, of Dahlonega is interested.

BIRMINGHAM, ALA.—J. B. Stagg, of Pratt City, has asked for a franchise to construct an electric railway from Pratt City to Brookside. The matter has not been acted upon.

NEWARK, OHIO.—The Newark & Granville Electric Railway Company has commenced work on a new power house near here. Contracts have been placed for two 300 hp. Corliss engines.

FOSTORIA, OHIO.—The Ohio Northwestern Railway, which was recently incorporated, has organized as follows: William D. Marks, president; J. A. Bradner, secretary and treasurer.

VINCENNES, IND.—The County Commissioners have granted a franchise to B. G. Hudnut, of Terre Haute, to build and operate seventy-five miles of electric railway in Knox County.

ANDERSON, IND.—The farmers in the southern part of this county have organized for the purpose of building an electric line from New Castle to Pendleton, a distance of thirty-five miles.

GARRETT, IND.—The Garrett, Auburn & Northern Electric Railway Company has been incorporated. The directors are J. D. Hauseman, F. S. Mitchell, E. B. Johns, J. F. Camerni and F. D. Welshmein.

CHATTANOOGA, TENN.—The Chattanooga Electric Railway Company has paid off $250,000 of its bonded indebtedness. This means the consolidation of its line with that of the Rapid Transit Company of Chattanooga.

CHILLICOTHE, OHIO.—A franchise has been granted the Columbus & Southern Electric Railway Company by the Ross County Board of Commissioners. The terminal points are Columbus and Chillicothe.

RAVENNA, OHIO.—The council has agreed to grant a franchise to the Northern Ohio Traction Company for its extension from Kent to this place. Contracts for rails have been placed and grading has been started.

CHICAGO, ILL.—The Riverdale, Harvey & Chicago Heights Railway Company has been incorporated with a capital stock of $10,000. The incorporators are Samuel M. St. Clair, George E. Ruher and Myles J. O'Kelley.

LYONS, N. Y.—The Palmyra Electric Railway Company has been incorporated, with a capital of $45,000 to build and operate an electric road at Palmyra. The incorporators are the Lyons Electric Light & Power Company and others.

CHICAGO, ILL.—The Chicago & Desplaines Valley Electric Railway has been incorporated. The capital stock is placed at $1,000,000. This completes the consolidation of the Desplaines Valley and the Chicago and Desplaines Valley railways.

CANTON, OHIO.—The Canton & Akron Electric Railway Company has been incorporated by W. H. Hoover, Charles A. Kolp, John C. Welty and Austin C. Brant, of Canton, and Philip Saltonstall and William Tucker, of Boston, Mass. Capital stock, $600,000.

FREMONT, OHIO.—The Lakeside, Napoleon & Western Railway Company, which proposes to build a line from Lakeside to the Indiana State line, has purchased the properties of the Fremont Electric Street Railway Company, operating the local line. Construction work has been started.

BRANFORD, ONT.—Messrs. Icaes & Armstrong, Pennsylvania capitalists, have asked the city council for a franchise enabling them to enter the city with an electric street railway, which will have its northern terminus at the city of Galt, Ont. The route for the road has already been laid out.

TOLEDO, OHIO.—The Cincinnati, Hamilton & Dayton Railroad Company will erect an immense elevator on the site of one recently destroyed in this city. It will cost $300,000, and all machinery will be operated from an independent power plant. The MacDonald Engineering Company has the contract.

TROLLEY FREIGHT.—In the case of the State vs. the Dayton Traction Company, tried in the Supreme Court in this city, the decision was in favor of the street railway company. The case was one in which the State sought to restrain the street railway company from operating freight traffic on city streets.

LIMA, OHIO.—The Western Ohio Railway Company has secured a franchise in Celina, and has the right of way between St. Mary's and Celina, and a branch will be built to the latter place. Right of way is being secured to extend the road from Minster to Sidney and Piqua, thus making connection with lines to Cincinnati.

TOLEDO, OHIO.—The Toledo & Ohio Northeastern Railway Company, recently incorporated, and which has secured a number of franchises in this State, is working for a right of way through Northern Indiana. It is the intention to build a direct line from Toledo to Chicago. W. H. Cummer is president of the company.

COLUMBUS, OHIO.—The Union Electric Railway Company, which is incorporated under the laws of New Jersey with $200,000 capital stock, has secured franchises over three different routes from the commissioners of Union county. The system will have fifty-three miles of track, and the power house and car barns will be located at Marysville.

DOVER, N. H.—Among the electric railway charters granted by the New Hampshire Legislature, are two for the formation of a trolley line connecting the cities of Dover, Somersworth and Rochester, with the State capital. The roads authorized are: The Concord, Dover & Rochester Electric Railway, capital $400,000, and the Dover, Somersworth & Rochester Street Railway, capital $300,000.

COLUMBUS, OHIO.—The stockholders of the Columbus, London & Springfield Railway Company have elected officers as follows: J. S. Harshman, president; Fred J. Green, vice-president; Emmett Thompson, secretary; John G. Webb, treasurer, and H. A. Fisher, general manager and second vice-president. The above and A. E. Appleyard and C. A. Alderman constitute the board of directors.

UTICA, N. Y.—Horace E. Andrews, representing a syndicate with headquarters at Cleveland, Ohio, purchased of President John W. Boyle, of this city, the controlling interest in the Belt Line and Suburban street railroads in this city and county. It is said to be the intention of the syndicate to build the projected lines up the Sauquoit Valley and to Clinton, and to parallel the Central Hudson from Rome to Little Falls .

NEW YORK, N. Y.—It is reported that A. L. Johnson has secured all of the necessary rights for the construction of his proposed electric railway between Philadelphia and New York. The roadbed will be in every respect equal to that of the standard steam railway. Ninety-five-lb. rails will be used, and the cars will have a seating capacity of 60 persons. Mr. Johnson is reported to have said that he expects to have the entire line between the two cities named, in operation by next Thanksgiving.

ANDERSON, IND.—The Union Traction Company closed the local power plant at Marion March 29, and began furnishing power from its central power house in this city for the local systems of Anderson, Marion, Muncie, Alexandria and Elwood and for its lines to Indianapolis, Marion, Muncie and Elwood. Only two of the two thousand horse-power engines are running, but they are sufficient. A third engine is being placed, and then all other local power stations on the entire system will be dismantled.

ALBANY, N. Y.—The Ellenville & Kingston Railroad Company has been incorporated with a capital of $300,000, to operate a standard gauge road by steam or electrical power, twenty-eight miles long, to connect with the Ellenville branch of the New York, Ontario & Western Railway Company, near Ellenville, Ulster County, and run to the city of Kingston. The directors are: Thomas H. Fowler, who subscribes for $200,000 of the stock, and John B. Kerr, O. D. Ashley, C. Ledyard Blair, F. K. Culbert, C. L. Hoyt, A. S. Roe, Grant B. Schley and Thomas B. Childs, of New York.

ALBANY, N. Y.—The New York & Port Chester Railroad Company has been incorporated with the Secretary of State to operate an electric street surface road, twenty-five miles long, from the Harlem River at Port Morris through the borough of The Bronx to Mount Vernon, Pelham Manor, New Rochelle, Larchmont, Orienta, Mamaroneck, Milton, Rye and Port Chester, to the Connecticut line, with a branch to Classon's Point on the East River. The company has a capital of $250,000, and the directors are: Charles Heinecke, of Whitestone; M. H. Germend, of Dumont, N. J.; W. H. Heath, of Brooklyn; M. H. Baldwin, E. D. Mailloux, Messmore Kendall, Christopher Kaiser, C. O. Mailloux, of New York City, and Ernest Muller, of Westfield, N. J.

THE AUTOMOBILE.

AUTOMOBILE RUN.—Mr. L. R. Adams, president of the Long Island Automobile Club, is sending out announcements that a 100-mile endurance test of the club will be run on Saturday, April 20. An informal smoker will be held in the club rooms, Brooklyn Borough, on the evening of April 19.

COLONEL MAX FLEISHMANN, of Cincinnati, is having constructed at the factory of the Automobile Company of America, Jersey City, N. J., a racing automobile. In the summer Mr. Fleishmann will make a trip from Cincinnati to New York and return. He will participate in the races at Newport, R. I., and in New York State; and will probably represent the Cincinnati Automobile Club in the race for the Gordon-Bennett Cup in France next summer.

THE CALIFORNIA AUTOMOBILE CLUB of San Francisco has been stirred up by the action of Stanford University in barring autos from the campus. The club will endeavor to have the roads opened and may have to resort to legal action. A hundred-mile race around San Francisco Bay from San Francisco to Oakland via San Jose is on the tapis. The North Pacific Coast Railroad Company and the Santa Fe Railroad Company now carry automobiles on their Bay ferries.

AUTOMOBILES FOR THE PAN-AMERICAN EXPOSITION.—The equipment of the Woods Motor Vehicle Company, of Wisconsin, which has a livery in this city, will be sent to the Buffalo Woods Motor Vehicle Company to be used during the Pan-American Exposition. The local company will temporarily close up its livery, but expects to reopen a new livery in the near future. The company reports having experienced a very satisfactory business during the one year of its existence.

AUTOMOBILES IN GOLDEN GATE PARK.—The Park Commissioners of San Francisco have put into operation the new rules governing automobile driving. All chauffeurs desiring the privileges of Golden Gate Park are required to subject themselves and their machines to an examination by the Park Engineer, as to speed and brake power of the automobile and the owner's ability as a driver. The maximum speed is limited to ten miles an hour. Non-transferable certificates are issued for each machine and its operator. Fifteen prominent chauffeurs were granted certificates at a recent examination.

NEW INDUSTRIAL COMPANIES.

THE JOY PRINTING-TELEGRAPH COMPANY, of New York City, has been incorporated; capital, $30,000. Directors: O. J. Smith, Dobbs Ferry; G. W. Cummings and J. H. Grant, New York City.

TRENTON, N. J.—The Frenchtown Electrical Construction Maintenance Company, Frenchtown, N. J., has been incorporated; capital, $50,000. Incorporators: Peter J. Magee, Franklin Dewsnap, James S. Gilbert.

THE PIXLEY ELECTRICAL COMPANY, Columbus, Ohio, was incorporated with $1,000 capital stock by M. A. Pixley, C. F. Pryor, H. W. Webb, J. F. Pixley and R. Fullerton. The company will deal in electrical and automobile supplies.

THE INTERNATIONAL ELECTRIC COMPANY has been incorporated at Trenton, N. J.; capital $3,000,000, to build and operate plants for the purpose of furnishing electric light, heat, and power. Incorporators: Adrian H. Miller, Charles M. King and Stephen C. Smith.

LEGAL.

TROLLEY FREIGHT.—It has been decided by the Ohio Supreme Court that street railroads have the right to carry freight.

TELEGRAPH SUIT SETTLED.—A Toronto, Ont., despatch states that the suit of Morrow & Clarke, of Boston, to annul the lease by which the Great Northwestern Telegraph Company has for seventeen years controlled and operated the lines of the Montreal Telegraph Company, has been settled out of court in favor of the defendants.

ANCHOR ELECTRIC COMPANY'S AFFAIRS.—Judge Bond, of the Superior Court, Boston, has appointed James E. Leach Receiver of the Anchor Electric Company. The appointment was made upon application of counsel for Norman Marshall and Guilford M. Stuart, who had brought a bill in equity against George C. and Guy H. Proctor, of Somerville. The plaintiff alleged mismanagement of the company by the defendants.

GAS INJUNCTION DISSOLVED.—The State of Illinois Appellate Court on April 8, in an opinion delivered by Judge Windes, reversed Judge Dunne's previous order and dissolved the injunction restraining the People's Gas Light & Coke Company from collecting more than 72 cents per thousand on fuel gas in Hyde Park. The injunction, which was granted about two months ago, caused a great deal of comment, as it was held that it established a precedent under which the rates charged by all street railways, gas, and electric companies and big corporations could be fixed by the municipal governments.

TELEPHONE DISCONNECTION.—The right of the telephone company to disconnect the citizen's service if the citizen is not prompt in paying his telephone bill was asserted not long ago by the Appellate Court of Indiana in the case of the Rushvile County Coöperative Telephone Company vs. Irvin (59 N. E. Rep. 328). The company had a rule that all moneys due it should be payable on the 5th of the month succeeding that in which the charges were incurred, and that if not paid by that date the service of the delinquent patron would be disconnected until the bill should be paid. The court held that this was a reasonable rule, and a proper way of obtaining payment of the bills.

OBITUARY.

MR. JAMES KNIBBS.—James Knibbs, Superintendent of the Troy (N. Y.) fire alarm system, died at his home there on April 16. He was stricken with paralysis a few days ago. Mr. Knibbs was born in England in 1823 and came to this country in 1840. He was twice married, his second wife surviving him. His only son died several years ago. Mr. Knibbs was very prominent in Masonic and Odd Fellows circles, but was best known throughout the country by his invention of what is known as the "Knibbs Run Around." This is an attachment to steam fire engines which prevents a waste of water and saves the hose and suction pipes. The "run around" was utilized almost everywhere, and by advice of counsel he brought suits against many municipalities. Many of the latter settled for large sums, but the City of New York defended the action. Recently a verdict was given in the United States Court for nearly $1,000,000 in favor of the persons to whom Mr. Knibbs assigned his invention. One of these is ex-Collector of Customs Thomas Murphy, of New York.

PERSONAL.

MR. T. A. EDISON entertained Mr. Marconi at his Orange Laboratory this week, together with Mr. John Bottomley and some railroad officials.

DR. H. T. BARNES, who has for some time past been engaged in special physical research at McGill University, Montreal, has been a visitor during the past week in New York city.

MAURICE J. FIEBERG, member of the Water Works Board of Cincinnati, is mentioned as probable president of the new lighting combination, to succeed General Andrew Hickenlooper.

MR. C. T. MURREY, who is identified with electric railway business at Buffalo, N. Y., it is reported, has been appointed general manager of the Toledo Traction Company, to succeed the late T. H. McLean.

MR. WILLIAM R. HEWITT has been appointed Permanent Chief of Fire Alarm Telegraph for the city of San Francisco. He has been at the head of the Fire Alarm and Police Telegraph system for the past thirteen years.

PROF. G. D. SHEPARDSON informs us that the legislature of Minnesota has just appropriated $60,000 for the State University at Minneapolis, for the College of Engineering. Most of the money will go into the electrical laboratory and lighting plant.

MR. L. E. FRORUP, for several years past with Schiff, Jordan & Company, has severed his connection with that firm, and on May 1 will become connected with the Falcon Electric Manufacturing Company, New York, as General Sales Agent for its various lines of well known specialties.

MR. CHARLES P. TURNER, M. E., who has been connected with the International Correspondence Schools, Scranton, Pa., since 1895, has resigned to accept a position with the Garrett-Cromwell Engineering Company, Cleveland, Ohio. Prof. Turner's successor as principal of the School of Mechanical Engineering is Prof. A. B. Clemens.

MESSRS. F. H. NALDER and P. A. Ransom, who have been making a rapid tour through the manufacturing districts of this country, besides visiting Canada, sailed for England last week. Mr. Nalder met many old electrical friends, who were glad to see him on this side again. Many establishments were thrown open wide to them, and a warm welcome met them everywhere.

MR. H. McL. HARDING, president of the United Telpherage Company, has started out on a long trip all through the Middle and Western States to lay out and arrange a large number of important agencies for the telpherage system, in regard to which the inquiries are already so numerous that the home office is swamped with them. Mr. Harding will visit all the larger cities and some of the mining districts.

HOUGH-WARD.—Lieut. Henry Hughes Hough, U. S. N., and Miss Flaurence Olyphant Ward, daughter of Mr. George Gray Ward, vice-president of the Commercial Cable Company, were married on April 16 in New York City at the Church of the Heavenly Rest by the Rev. Dr. D. Parker Morgan, rector of the church, and the Rev. Reese F. Alsop of St. Ann's Church, Brooklyn. The bridesmaids were Miss Florence Stebbins, of New York; Miss Harriet Brownson, daughter of Captain Brownson, United States Navy; Miss Cornelia Knox, daughter of Lieut. Col. Knox, United States Army; Miss Rose Hoppenstedt, Miss Alice Byrne, and Miss Addie De Witt, of Brooklyn. The maid of honor, Miss Helen Holmes, was in pure white. The ushers and best man, all naval men, were in the uniform and were as follows: Lieut. De Witt Blamer, United States Navy, best man; Lieuts. H. H. Caldwell, A. E. Dewie, A. Allthouse, and C. F. Preston, United States Navy; Capt. R. H. Lane, United States Marine Corps; Lieut. Irwin, and Naval Constructor R. M. Watts, United States Navy. A reception followed the ceremony at the residence of the bride's parents, 51 West Fifty-third Street, which was largely attended, the guests and friends including many people well known in electrical circles.

Trade Notes.

THE UNION HARDWARE & ELECTRICAL SUPPLY COMPANY, Providence, R. I., was burned out recently.

BUSINESS CHANGE.—The Elwood Electric Company, Rochester, N. Y., has been succeeded by the J. B. Snyder Supply & Electric Company.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, recently entered a twelfth order for Cross oil filters for the International Paper Company.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that it is making large shipments of Packard transformers, for which it is general Western agent.

ROSSITER, MACGOVERN & COMPANY are moving from their Brooklyn factory, Raymond and Willoughby Streets, to 14 and 16 Morris Street, Jersey City.

THE TRIUMPH ELECTRIC COMPANY, Cincinnati, Ohio, has sold a large generator and several motors for installation in a large power plant in Baltimore.

CHICAGO OFFICE OPENED.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has opened a branch office at No. 40 Fisher Building, Chicago, Ill. This office will be in charge of Mr. C. H. Norwood.

WATER TUBE BOILERS.—The new plant which is now in course of construction for the Champion Coated Paper Company at Hamilton, Ohio, will contain Stirling water tube boilers with a capacity of 3,200 horse-power.

THE CHRYSLER RAILWAY SCHOOL has been incorporated in Indianapolis, Ind., for the purpose of instructing and preparing men for service on electric and steam railways, and to assist them in obtaining employment.

DAMAGE BY FIRE.—The building on Canal Street, New York, in which was located the factory of J. H. Bunnell & Co., was recently destroyed by fire. The Bunnell Company's loss was $75,000. The firm is now fitting out a new factory.

THE BUNNELL TELEGRAPHIC & ELECTRICAL COMPANY, of New York, has purchased the property of the National Electrical Manufacturing Company in Milford, Conn., for $12,500. Mr. Albert J. Wisé represented the company in the negotiations.

MILWAUKEE, WIS.—The Browning Manufacturing Company is now turning out its small power motors from the new plant. The new shop is modern by equipment in every respect. The company is crowded with orders, and has several orders booked for foreign shipment.

FIFTIETH ANNIVERSARY.—The American Steam Gauge & Valve Company, Jamaica Plain, Boston, Mass., celebrated the fiftieth anniversary of its organization on Tuesday evening, April 16. The company was organized in 1851. Invitations to attend the celebration were sent out to the trade.

THE BERLIN IRON BRIDGE COMPANY has contracted to furnish the Province of New Brunswick, Canada, four bridges. There will be required four 63-foot riveted spans, one 150-foot through pin-connected span, one 200-foot deck pin-connected span, and one 80-foot deck pin-connected span.

SUPPLY BUSINESS FOR SALE.—The stock in trade, fixtures, leases, etc., of the Anchor Electric Company, 71 Federal Street, Boston, Mass., was advertised to be sold at public auction by the receiver on April 16. The business of the concern was carried on by the receiver until the day of the sale.

CONSTRUCTION MATERIAL.—The Central Electric Company, of Chicago, carries in stock large quantities of construction material, such as cross arms, pins, brackets, insulators, wires, etc. By making a specialty of prompt shipments this company is in a peculiarly good position to handle large construction orders.

MACHINE TOOLS.—The Newton Machine Tool Works, Philadelphia, Pa., has issued a catalogue, No. 34, of its extensive line of machine tools. This company makes a line of electrically driven tools of every description. The catalogue contains 192 pages and is very fully illustrated with cuts of machine tools of all kinds.

DIEHL ELECTRIC FANS.—The Diehl Manufacturing Company, Elizabethport, N. J., has issued a catalogue describing and illustrating its line of 1901 fans. This company is making these machines for all currents except alternating. The fans are of the ceiling, electrolier, column, desk, bracket and telephone booth types.

REMOVAL.—John W. BROOKS, sales agent for Pass & Seymour, Syracuse, N. Y., announces that the company's Chicago office and stockroom has been moved to 130 W. Jackson Boulevard. This change was made necessary in order to obtain more room to take care of the rapidly increasing demand for the P. & S. specialties.

CONTINENTAL ENCLOSED ARC LAMP.—This lamp, which is designed for 110-volt direct-current constant-potential circuits, is the subject of Bulletin D, just issued by the Helios-Upton Company, Philadelphia, Pa. It is claimed that a gain of light and economy of 35 per cent. over other lamps is effected by the use of the Continental lamp.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., is carrying a stock of standard apparatus at its Westfield, N. J., factory, and at its New York office, 136 Liberty Street, for the convenience of its eastern customers. It also has facilities at its Westfield factory for manufacturing any special motor controlling devices promptly.

WORM GEAR CUTTING.—The Garvin Machine Company, New York, on a large mailing card announces that it has facilities for quick cutting and finishing gears with standard hobbed teeth up to 20 inches diameter. A list of the standard hobbs in stock is given. The company also announces that it cuts and planes beveled gears up to 12 inches in diameter.

CONVEYING AND HOISTING MACHINE.—The C. W. Hunt Company, of West New Brighton, N. Y., has issued a neat little pamphlet giving an introduction to the general line of machinery manufactured by it. Only a portion of the manufactures is illustrated. The list includes industrial railways, electric locomotives, steam and electric hoisting engines, etc.

ELECTRIC PLANTS IN FOUNDRIES.—Representatives of the Carnegie and Federal Steel Companies have been inspecting the electric plant of the Bullock Electric Manufacturing Company in Norwood, Ohio. The gentlemen propose to construct an electric plant at Youngstown, and the Carnegie Company is contemplating the installation of several like plants in Eastern Pennsylvania.

LIGHTNING ARRESTERS.—The Garton-Daniels Company, Keokuk, Ia., in pamphlet No. 28, just issued, illustrates and briefly describes the Garton lightning arrester for use on electric railways, light and power circuits, either for direct or alternating currents. The operation of these devices is fully described in the company's general catalogue, which may be obtained on request.

TELEPHONES AND SWITCHBOARDS.—The Sun Electric Manufacturing Company, Philadelphia, Pa., has issued a 28-page catalogue of its line of telephone apparatus. This company has a new manufacturing plant which is strictly up to date, and it guarantees its apparatus, both as to its efficiency and mechanical construction. The illustrations show the construction of these devices very clearly.

H. F. BORBEIN & COMPANY.—The business of H. F. Borbein & Company, manufacturers of automobiles, running gears and parts, St. Louis, Mo., has been bought by the Brecht Automobile Company. The latter concern will manufacture automobiles and running gears on a large scale at 1201 Cass Avenue, St. Louis. Mr. H. F. Borbein, who is interested in the new company, will be manager of the mechanical department.

THE H. C. ROBERTS ELECTRIC SUPPLY COMPANY, Philadelphia, has recently added to its already extensive list of good agencies, an agency for the Guttmann wattmeter. It reports having received numerous orders, many of which are duplicate ones, which speaks well for the meter. Mr. Roberts also reports being extremely busy in other lines and that the outlook for spring business with the company is most encouraging.

SIMPLEX TELEPHONES.—The Simplex Interior Telephone Company, of Cincinnati, Ohio, describes and illustrates its various styles of telephone apparatus for factories, stores, offices, hotels, residences, street railways, etc. The company's products embrace intercommunicating instruments, telephones for short line work, hotel and telephone annunciators, hotel telephones, switchboards for apartment houses, and street railway telephones.

TELEPHONE APPARATUS.—The Haines & Noyes Company, Chicago, Ill., has issued six bulletins, A, B, C, D, E and F. These are devoted to descriptions and illustrations of the various styles of telephone apparatus manufactured by this company. Bulletin A relates to intercommunicating systems; B, apparatus for hotels and public buildings; C, apartment house telephones; D, telephone exchanges; E, railroads, and F, grange and party lines.

VOLTAGE REGULATORS.—Mr. W. H. Chapman, Portland, Me., manufacturer of the Chapman Voltage Regulator, has recently removed his headquarters to the Southworth Block on Middle Street, where increased factory facilities have put him in position to handle his increasing business more promptly than ever. He reports that the demand for these instruments is rapidly increasing, and many duplicate orders are being received from various parts of the country.

PROTECTIVE PAINT is a necessity in the maintenance of iron and steel structures. The "Carbonizing Coating" manufactured by the Goheen Manufacturing Company, Canton, Ohio, is recommended by the manufacturer as a durable and perfect protective paint and a preservative from rust and corrosion. In a catalogue just issued by the company many illustrations of buildings, railroad trestles, roofs, etc., treated with "carbonizing coating," are shown in connection with copies of testimonial letters.

DRAWING INSTRUMENTS.—Because of the difficulty experienced by its students in small towns in securing suitable drawing instruments, the International Correspondence Schools of Scranton, Pa., have arranged to sell an outfit to students only at about half the usual retail price. Among the recent visitors at the International Correspondence Schools were Arnold Shanklin, of the National Cash Register Company; K. Yonekra, chief engineer of the Hakkaido Coal & Railroad Company, Japan, and K. Kamio, electrical engineer of the same company.

I. T. E. CIRCUIT BREAKERS.—"Circuit Breaker Practice" is the title of a publication of the Cutter Company, Philadelphia, treating of the progress made in the art and the development of various types of circuit breakers for special uses. The April number, which is the first one, includes the following articles: The Principle of Automatic Circuit Breakers; Circuit Breakers Contrasted with Fuses; Circuit Breakers as Indicators, and Circuit Breakers for the Protection of Generators. The publication is in pamphlet form and the type is unusually large so as to facilitate easy reading.

PUMPING MACHINERY.—A general catalogue has just been issued by the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, in which are illustrated and described pumping machinery, jet and surface condensers, air compressors, etc. In addition to this line of work the company manufactures the Victor turbine water wheel, and the Stilwell motor and purifier for exhaust and waste steam. The catalogue contains 124 pages and is very artistically illustrated with the various types of machinery described. In addition to the descriptive and illustrative matter there are some useful engineering tables.

PROGRESS IN RAILROADING.—In a leaflet issued by the New York Central & Hudson River Railroad Company, some idea of the marvelous development in railway practice is given. It appears that in 1844 it took 30½ hours to travel by mail train from Albany to Buffalo. Now it takes 5 hours and 37 minutes by the Empire State Express. In 1844 the cars were lighted with candles; there were no sleeping cars and meals were obtained at primitive taverns. In 1901 the cars are lighted by both gas and electricity, and the trains include sleeping cars at night and parlor cars by day, together with dining cars, etc.

MR. J. L. PUTNAM, the engineer of The Clark Automatic Telephone Switchboard Company, of Providence, has just returned from Buffalo, where he has been spending considerable time upon the exhibit which the company is preparing for the Pan-American Exposition. The automatic telephone will probably prove one of the most interesting attractions among the electrical exhibits for manufacturers and others who have need of large interior systems and for municipal authorities looking for the cheapest method of installing and maintaining a telephone system in their community. The need is growing daily, and there is doubtlessly a good future in store for the company which can meet the requirements.

THE RAHN-MAYER-CARPENTER COMPANY, of Cincinnati, manufacturer of engines and turret lathes, has sent out a celluloid match safe with the name of the recipient engraved thereon. On one side is a fac-simile of a portion of its letter-head, while on the reverse side is an illustration of its lathe. The company is sending out this matchbox not only to call attention to the lathe, but as a reminder of the fact that it is built only by skilled artisans, who have been picked from among the best mechanics in America, therefore guaranteeing that every machine turned out by it will be just as carefully made as it is possible for skilled workmanship to produce.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, of Pittsfield, Mass., announces the issue of a new Bulletin. This one is No. 116, and illustrates and describes a new type of S. K. C. static ground detector, designed for circuits carrying very high voltages. This is said to be the first instrument of the kind combining thorough reliability with absolute immunity for switchboard attendants from danger of shock. The vanes of the instruments are charged statically through the medium of condensers, thus live wires are kept out of and entirely away from the instrument. Those familiar with ground detectors and their uses and advantages will be prompt to appreciate its superiority. A copy of the bulletin will be mailed to all such upon request.

ANNIVERSARY CELEBRATION.—The W. R. Garton Company will celebrate its third anniversary on May 1 by moving into its new quarters at 118 Jackson Boulevard, West, Chicago. Its business has shown a substantial growth and extends practically from one coast to the other. It has also built up a very nice foreign trade and it is now compelled to get into larger quarters to accommodate its expanding trade. The W. R. Garton Company acts in the capacity of manufacturers' agent and engineer, and although it started out to confine its trade to the railway field, it is compelled to take care of an increasing business in the electric light and power departments as well. The company will be prepared to take prompt care of this business in its new quarters.

HOTEL TELEPHONE EQUIPMENT.—The Lambert Schmidt Telephone Manufacturing Company has just secured a contract for equipping the Majestic Hotel, Seventy-fourth Street and Central Park West, with a 400-drop switchboard equipment, this installation being one of the largest of its kind in New York. Its common battery system will also be used there. The company makes a specialty of this class of installation, and already numbers many of the higher grade of apartment houses and hotels among its patrons. Instances of this same system in factory use are its recent installations of large switchboards and telephones at Messrs. Lehn & Fink, William and John streets, New York; the Fulton Foundry & Machinery Works, Brooklyn, N. Y., and many others.

THE PHOENIX ELECTRIC TELEPHONE COMPANY, New York, has just closed contracts with the Amsterdam Automatic Telephone Company, Amsterdam, N. Y., for a 300-drop trunking switchboard and a 300-drop combined lightning arrester and distributing frame; a complete 700-drop plant, including switchboards, lightning arresters and distributing board, with the latest type of long distance telephones, for the Colonial Telephone Company, of Newburgh, N. Y.; a complete 500-drop plant for the Dutchess County Telephone Company, Poughkeepsie, N. Y., and five switchboards and combined lightning arresters, of from 50 to 200 drops each, and 500 telephones, for the South Carolina Long Distance Telephone Company, Columbia, S. C. The Phoenix Company is again doubling the capacity of its factory.

INDUCED DRAFT.—The equipment of the great shipbuilding plant of the Fore River Engine Company at Quincy Point, Mass., exemplifies in marked degree the varied applications of the fan blower. Draft for its boilers is produced by an induced draft fan drawing the gases directly from the uptake flue and discharging them through a small stack extending only a few feet above the roof. Under the forced system fan draft is likewise employed for creating the necessary intensity of combustion in the heating furnaces and forges while the smoke is removed from the forges through hoods communicating with an exhaust fan. All buildings are heated by the hot blast system, and notwithstanding their exposed position this, the first winter, has been passed with perfectly uniform internal temperature throughout all of the buildings. The entire equipment of blowers and heating apparatus was installed by the B. F. Sturtevant Company of Boston, Mass.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has just issued to the trade two catalogues, one on direct, and the other alternating current fan motors and ceiling fans. It is offering for alternating currents the New Model 1901 Emerson desk fan motors and ceiling fans. It has handled this fan for some years. The Emerson fan is too well known to need description. It calls special attention to the Parker noiseless blades with which all its fan motors are equipped. These are patented. They do away almost entirely with humming noises. For direct current it is offering the Peerless desk fan motors and ceiling fans, and is now prepared to make shipments for any voltage. In the Peerless it has a fan simply and strongly made, graceful in appearance and practically noiseless in operation. It has self-oiling and self-aligning bearings and self-adjusting carbon brushes; the highest possible efficiency, and the price is low. They mail these catalogues on application.

NEW EAST RIVER BRIDGE.—On April 7, the John A. Roebling's Sons Company took the first important step in the making and laying of the cables for the new East River bridge at New York. The contract was awarded to the company several months ago, and the preparations of plans and other preliminary work, as well as the main part of the contract, which is to follow, is under the supervision of Mr. Charles G. Roebling, the president of the company, who is assisted by Mr. William Hildenbrand. The work done last week was the placing in position of the 2¼-inch diameter ropes which support the temporary foot bridge on which the workmen will stand during the main work of cable laying. Several methods of getting the first line across have been employed in the past, and kites, swimmers and other agents have been tried, but the method employed on this occasion has, it is believed, never been tried before, and is a distinct advance over all previous ones. The method adopted was to carry the drum containing the cable across the river on a float (one end having previously been secured) and pay out the cable allowing it to rest on the river bed until at the proper time it could be raised from the water and to the desired height by means of a stationary engine and drum. The first cable was successfully raised on April 11, the time required being only seven minutes, navigation being, of course, suspended during that period.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 9, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney Times Bldg., N. Y.]

671,438. TROLLEY FINDER FOR ELECTRICAL RAILROADS; P. Goldsmith, Troy, N. Y. App. filed Aug. 16, 1900. Insulated seats for the wire are placed adjacent to the trolley wheel and the wire is directed into these seats when it leaves the main contact wheel.

671,445. DOOR FOR TROLLEY CAR BARNS; W. R. Kinnear, Columbus, Ohio. App. filed Nov. 7, 1900. The doorway is closed by a vertically moving curtain having a section of the trolley wire on its lower edge.

671,458. ELECTRIC TELEPHONE RECEIVER; E. H. Strauss & F. J. Stein, Chicago, Ill. App. filed Aug. 13, 1900. Details of construction.

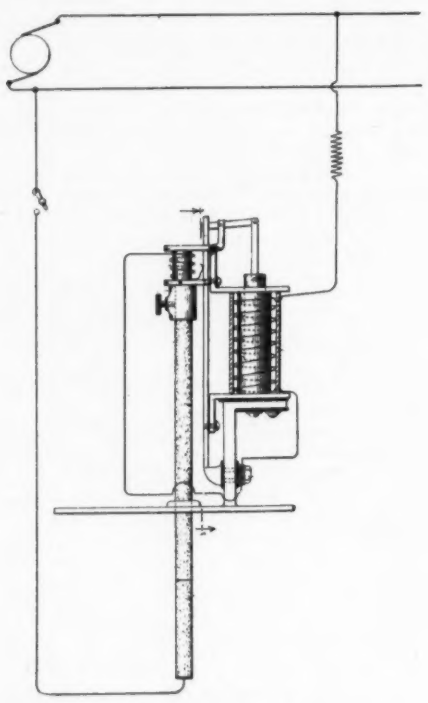
671,473. HOLDER FOR TELEPHONE RECEIVERS; T. Emerson, Newport, R. I. App. filed Sept. 27, 1900. A bracket to support the receiver while it is in use.

671,482. ELECTRIC RAILWAY SYSTEM; P. E. Herkner, Berlin, Germany. App. filed Nov. 30, 1900. The resistances which are used in controlling the motors on the car are in the form of magnet spools, so arranged as to magnetize the wheel, so that during acceleration or braking or whenever an excessive supply of current occurs, a maximum track adhesion will be obtained without the operation of any separate switching device.

671,489. BOOSTER CRUSHER; M. Pfatischer & C. H. Bedell, Philadelphia, Pa. App. filed Aug. 24, 1900. Automatic devices are arranged to alter the field magnet of a motor-generator in such a manner as to increase the difference of potential between two points of a generator circuit, or decrease the same in order to keep the said difference of potential constant.

671,490. CONTROLLER FOR ELECTRIC MOTORS; W. B. Potter, Schenectady, N. Y. App. filed Dec. 30, 1897. A switch is so arranged that it will reduce the controlling resistance by one-half and at the same time double its current carrying capacity when the motors are connected in parallel.

671,491. SYSTEM FOR TRAIN CONTROL; W. B. Potter, Schenectady, N. Y. App. filed June 12, 1899. In an electric train system, a plurality of motor cars, a controlling system for said train, and a controller provided with means for adjusting its capacity to correspond with the number of motor cars in the train.



671,512.—Electric Arc Lamp.

671,512. ELECTRIC ARC LAMP; T. E. Drohan, Chicago, Ill. App. filed June 12, 1900. The feed of the carbons is controlled by a magnetic clutch.

671,515. CONTACT SHOE FOR ELECTRIC RAILWAYS; G. T. Hanchett, Hackensack, N. J., and J. M. Murphy, Torrington, Conn. App. filed July 27, 1900. The contact shoe has a curved contacting face and is pivoted at one end to a link which is pivotally connected with the hanger, the shoe thereby being free to rock upon the conducting rail.

671,603. ELECTRIC LAMP RECEPTACLE; W. E. McDonald, Chicago, Ill. App. filed Sept. 22, 1897. Provision is made for inserting the lamp receptacle in a line of tubing.

671,618. FLEXIBLE AND ADJUSTABLE SUPPORTING DEVICE FOR ELECTRIC LAMPS; W. F. Brewster, New York, N. Y. App. filed Nov. 30, 1900. For electric sign purposes the lamp receptacles are mounted upon pivotally connected sections, so that the shapes of the figures making up a sign, may be varied at will.

671,619. FLEXIBLE SUPPORTING STRUCTURE FOR ELECTRIC LAMPS; W. F. Brewster, New York, N. Y. App. filed Nov. 30, 1900. A modification of the preceding.

671,660. ELECTRICALLY OPERATED FAN; R. W. Schmelz, Brooklyn, N. Y. App. filed Nov. 6, 1900. Two solenoids are arranged to vibrate a swinging fan or punkah.

671,662. ELECTRIC MOTOR; H. P. White, Kalamazoo, Mich. App. filed Oct. 5, 1899. The armature and field magnet both rotate, and are connected together through a differential gearing, so that as the motion of the field magnet is lessened, the greater will be the speed of the armature, though it will then run with less torque, and vice versa.

671,715. SYSTEM OF ELECTRICAL DISTRIBUTION; C. I. Young, Philadelphia, Pa. App. filed Aug. 8, 1899. (See Current News and Notes.)

671,725. HEATER FOR ELECTRIC GLOW LAMP; Frederick M. Goddard, of Pittsburg, Pa. App. filed July 20, 1899. The heating wire is wound in grooves in one face of a flat body of insulating material like talc.

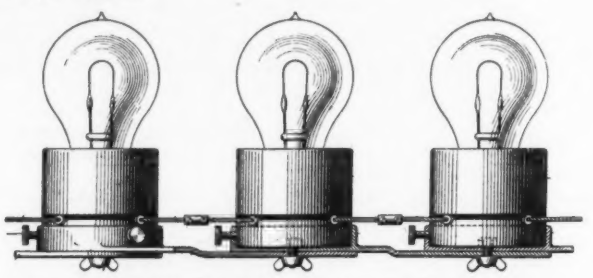
671,730. FREQUENCY OR SPEED INDICATOR; R. D. Mershon, New York, N. Y. App. filed July 12, 1899. (See Current News and Notes.)

671,732. WIRELESS TELEGRAPH SYSTEM; H. Shoemaker, Philadelphia, Pa. App. filed Oct. 18, 1900. Relates to the construction of the plugs between which the metallic particles in the tube of the coherer are confined.

671,762. JUNCTION BOX; E. T. Greenfield, New York, N. Y. App. filed March 2, 1901. The necks of the junction box with which the tubes are connected are given a bell shape internally, so as to avoid injuring the conductors when they are drawn through.

671,763. JUNCTION BOX; E. T. Greenfield, New York, N. Y. App. filed March 2, 1901. A modification of the preceding.

671,776. ANNUNCIATOR; D. Rousseau, New York, N. Y. App. filed July 21, 1899. Details.

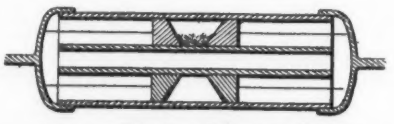


671,619.—Flexible Supporting Structure for Electric Lamps.

671,863. TEMPERATURE ALARM AND INDICATOR FOR CAR AXLE BOXES; R. C. Callum, Washington, D. C. App. filed Oct. 5, 1899. A thermostat located in or near the axle box will send an alarm to the engine cab, when the temperature of the axle rises above a certain degree.

671,866. ELECTRIC RAILWAY SYSTEM; J. M. Murphy, Torrington, Conn. App. filed Aug. 4, 1898. An electric railway system, having an electromagnetic switch for shunting the feed circuit and initially operated by a source of energy on the car, said source of energy comprising a rotary transformer having an auxiliary winding for the field-cores in circuit with the high potential armature through the switch-controller.

671,876. SELF-LOCKING INSULATOR; W. P. Beardsley, Altoona, Pa. App. filed March 19, 1900. A device whereby the wire will be automatically locked in the insulator against sagging after having been stretched during the operation of stringing.

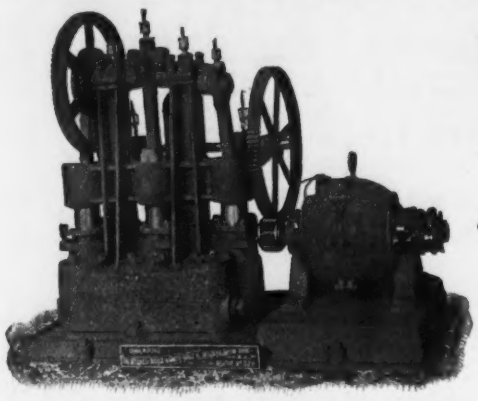


671,732—Wireless Telegraph System.

671,883. ELECTRIC SWITCH; F. Head, Philadelphia, Pa. App. filed Jan. 28, 1901. An electric switch operated by fluid under pressure, said switch having a magnet to govern the pressure at which it opens and having a spring operative upon the movable member of the switch which determines the pressure at which it closes.

671,891. ELECTRIC TOY; A. A. Kent, Lebanon, N. H. App. filed Jan. 29, 1901. An electric motor adapted to rotate a number of color disks is started by giving its armature spindle a twist which at the same time closes the motor circuit by stopping the spindle. The circuit automatically opens, the device being therefore easily handled by a child.

671,907. CONTROLLER FOR MOTORS; F. B. Duncan, Madison, Wis. App. filed July 9, 1900. The operation of the rheostat is controlled by a solenoid and a spring; the solenoid releases the moving arm so that it may travel back on the action of the spring.



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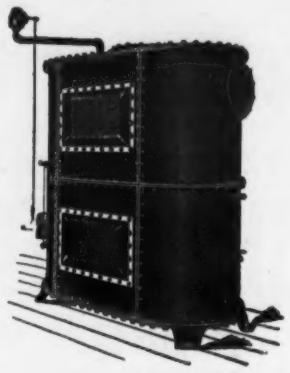

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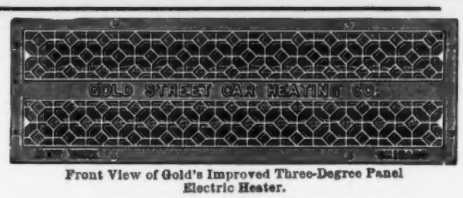

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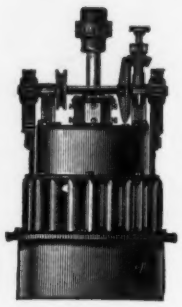

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